537.05
E38
W9

PUBLICATION OFFICES:
168–177 POTTER BUILDING, NEW YORK.
Telephone Call: Murray 586. Cable Address: "Electrical," New York.
New England Office, 48 Congress Street, Boston.
Western Office, 44 Lakeside Building, Chicago.

W. J. JOHNSTON. Editor and Publisher.
T. COMMERFORD MARTIN, JOSEPH WETZLER, } Associate Editors.
G. H. STOCKBRIDGE, Assoc. Editor Patent Department.
CLARENCE E. STUMP, Business Manager.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.00.
(Postage Prepaid in the U. S. or Canada.)

CLUBS.—In clubs of 4 or more, $2.50 a year each; with a free extra copy to the getter-up of a club of 8.
Subscription to foreign countries, $4 a year.

In requesting your address changed, give old as well as new address.

THE ELECTRICAL WORLD
HAS THE LARGEST CIRCULATION
OF ANY ELECTRICAL JOURNAL PUBLISHED, AND IS
THE BEST ADVERTISING MEDIUM.

Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions.
Notices of Situations or Help Wanted, $1 to $3 an issue.

Correspondence, views and opinions on all topics within the province of this journal are cordially invited from any part of the world. We will thank readers to forward to us—**promptly** as they occur—**Items of News,** or information relating to any application of Electricity, also marked copies of their local papers containing anything likely to interest electricians. Anonymous communications cannot be noticed, nor can rejected manuscript be returned, unless accompanied by the necessary postage when received.

Matter for the **Editorial** Department should be addressed to
The Editor of The Electrical World, New York.
Subscriptions and communications relating to **Advertising** or the **Business Department** should be addressed to
W. J. JOHNSTON, Publisher,
Potter Building, New York.
OR ANY OF THE BRANCH OFFICES.

CONTENTS.

	Page.
ILLUSTRATED ARTICLES:	
Meeting of the Electrical Section of the American Institute	136
The Engine Room of the Brush Station at Cleveland	137
The Christie "Telescope" Pulley	144
A Novel Burglar Alarm	145
The "Perfection" Iron Box Bell	145
A New Police Visual Signal	145
Adjustable Drop Sight Feed Oiler	145
EDITORIAL PARAGRAPHS	135
MISCELLANEOUS:	
Another Western Union Dividend Passed	136
Peltier's Phenomenon in Liquids	136
Bernstein's New Filament	136
Spongy Carbon for Primary and Secondary Batteries	136
The "Regent" Primary Battery	137
A Practical Use of the Microphone	137
MISCELLANEOUS:	
St. Louis Meeting of the National Telephone Exchange Association	138
Progress of the New York Subway	144
The Toronto Exhibition Electric Railway	144
Power Required for Running Arc Lamps	144
Opening of the Van Depoele Electric Railway in Detroit	145
The Commercial Union Telegraph Company	145
Electric Photography	145
DEPARTMENTS:	
New York Notes	146
New England Notes	146
Western Notes	146
The Telegraph	146
The Telephone	146
The Electric Light	146
Applications of Power	147
Miscellaneous Notes	147
Personals	147
Sparks and Flashes	147
Stock Quotations	147
Business Notices	147
Our Illustrated Record of Electrical Patents	147–8

New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

	Page.
Railway Telegraph Supply Co.—Telephone Supplies, Battery Material, Line Equipment, etc.	vii
The Ames Mfg. Co.—Electrical Machinery	xvi
W. J. Johnston.—New Book, "Arc and Glow Lamps"	xvi
The Seibert Cylinder Oil Cup Co.—Automatic Sight Feed Lubricator	xvii
Boston Rubber Shoe Co.—Rubber Tape	xvii
Charles D. Wright.—Wright's Reducer	xx
Keating Electrical Co.—The Keating Sounder and Key	xx
Stout-Meadowcroft Co.—Edison Lamps	xx
For Sale and Wants	148

Vol. VIII. NEW YORK, SEPT. 18, 1886. No. 12.

ANOTHER Western Union dividend has been passed. Is the company still in sore straits, or are there more shareholders to be shaken out before the stock booms?

IT is true that in many parts of Third avenue the structure of the elevated railway gives that thoroughfare a dark, underground appearance, but there is scarcely sufficient warrant in such gloominess to excuse the Western Union Company for looking on the elevated track as a subway within the meaning of the law.

THE uses to which the telephone can be applied are widening every day. Not long since we gave an account of the manner in which a ground in an underground electric circuit could be located with certainty, and this week we publish an interesting note relating to the finding of a break in a water main. The induction coil in one case and the microphone in the other in connection with the telephone were the means of saving both time and money, not to speak of the possible dangers averted, by the quick location of the faults and their repair.

OWING to the pressure upon our reading and advertising columns, we are again compelled to issue a paper of 44 pages. Last week we devoted no fewer than nine pages to the report of the National Electric Light Association meeting, and this week we give six pages to the report of the St. Louis meeting of the National Telephone Exchange Association.

IT will be noticed, from the change in the imprint on this page, that Mr. G. H. Stockbridge has become the editor of the Patent Department of THE ELECTRICAL WORLD. Mr. Stockbridge was for some time a member of the examining corps, in the United States Patent Office, in the class of electricity, and is thoroughly familiar with the state of the art. Under his editorship, we hope to render our Patent Department more efficient than ever. It will be seen also, from an announcement made under "Business Notices," that Mr. Stockbridge assumes the management of Johnston's Patent Agency.

SOME time ago, it will be remembered, the insurance regulations prohibited the running of incandescent lamps from arc circuits, but later improvements caused the prohibiting clauses to be rescinded. The Boston Tariff Association has now given its sanction to this method, which is increasing in popularity and efficiency, and has formulated a new set of rules for its installation. Although the new rules state that the running of incandescent lamps on arc circuits should be avoided; still, wherever this is unavoidable, proper devices or distributors should be employed, together with the other usual safety appliances. Looked at from the side of practicability, there can be little objection to the system if properly arranged, and the cases of "unavoidability," we think, are likely to increase.

THE various mechanical methods which have been devised to give an alarm for lower water in steam boilers have not come into extensive use for numerous reasons, among which the manner of their connection with the boiler is not the least important. More than one electrical method has also been devised. That shown in our columns this week and described by Mr. J. J. Ghegan before the Electrical Section of the American Institute seems destined to a wide application. Its chief merit evidently lies in the fact that it can readily be attached to a boiler whether the latter be in operation or not, and that its construction is such that it can readily be tested at any time. Mr. Ghegan draws attention to the fact that the same force which signals an alarm is capable of operating mechanism for the supply of water to the boiler, and this automatic action in itself is a valuable addition to the function of the apparatus. Considering the large number of steam boiler explosions traceable to "low water," the apparatus has a career of usefulness awaiting it.

IT is curious to note the difference of opinion on the results obtained with aërial and underground cables. As we chronicled at the time, Mr. W. W. Jaques some months ago brought out a formula which gave the length to which a telephone cable could be successfully worked when its resistance and static capacity were known; and Mr. Fay, with the object of determining its accuracy, sent out lately letters inquiring for information regarding the working of the cables in various telephone companies. While the answers received to his general questions are satisfactory enough, the lack of testing instruments made impossible the determination of the principal question relating to the formula. This is to be regretted. The replies received, however, show that a fruitful source of trouble is found in the cable terminals, upon which moisture accumulates. Another fact, more encouraging to note, is that, according to the replies, very little, if any, difference is detected between the operation of aërial and underground telephone cables.

MR. T. D. LOCKWOOD'S interesting paper read at the St. Louis Telephone Convention draws attention to the methods of protecting telephone lines from the effects both of lightning discharges and from accidental crossing with electric light wires. He signalizes the necessity of protecting the lines not only at the exchange end but at the subscriber's station as well. The idea that protection at one point in the line is sufficient has been shown to be erroneous by the burning out of numerous instruments, not to speak of the fires caused in the telephone exchanges. Regarding lightning protectors, Mr. Lockwood reasons well when asserting that they should be constructed so as to be equally efficient, whether the discharge be a direct one, or whether it be the equalizing discharge from the earth, due to a discharge at a distant point. In discussing the relative merits of the two general classes of protectors, viz., the electro-magnetic and the electro-thermic, Mr. Lockwood, while noting the fact of the retarding influence produced by the former when introduced in the circuit, prefers them on the ground of greater constancy and rapidity of action. The use of tinfoil strips seems to be looked upon by him as not well adapted to the purposes of protection. The paper as a whole is a most valuable review of an important subject, and will no doubt be read with profit by exchange managers as well as by electricians generally.

THE progressive spirit of our large telephone companies in seeking to remove overhead wires where possible is becoming more and more evident. In describing the underground work done in Brooklyn, Mr. W. D. Sargent pointed out at the St. Louis Telephone Convention, that his company had just begun to make arrangements to bury part of its wires, when unfortunately for their good intentions the New York law was passed making their action compulsory. Since then work in Brooklyn has been progressing rapidly and with good results. We now learn that the Bell Telephone Company, of Philadelphia, is voluntarily taking initial steps to bury its wires so as to enable the company to reach every building, from below the surface, in the main district of the city. A novel method of main conduit is proposed which will consist of cedar logs, six inches square, with holes three inches in diameter, through which the cables will be drawn. The manholes will be wooden boxes, covered with a lid, and paved over. It is stated that it will require nearly four years to carry out the system in its entirety, and that it will cost in the neighborhood of $2,000,000.

OUR report of the proceedings of the National Telephone Exchange Association presents the telephone men of the country in a favorable and creditable light. They are seen discussing with fairness and intelligence the problems of the business, and show themselves anxious to deserve as well as win public esteem. Mr. Fay, in his opening address, brings together some remarkable figures to prove that the return on the investment in telephony is by no means large, and we have doubts whether any one can upset his calculations or criticise them as other than conservative. We believe that but one original Bell Company forfeited its franchises—that for New Mexico—and we know that some of the older companies are still making handsome returns—that in New York, for example; but, taking the business as a whole, Mr. Fay's low estimate of profit is probably near the mark. Even if the telephone had been the means of creating gigantic fortunes, it would still be a greater benefactor of the people than of individuals. In fact, the mere bruit or rumor of millions made out of telephony has done much to stimulate activity in other electrical fields, and hence to confer wide-spread benefits on the public. The desire for wealth may not be the highest, but it has given to the public some of her noblest States, and to England some of her finest colonies. As Mr. Fay remarked, however, he could look around the convention without seeing a single millionaire, though he could see many a man who in telephonic development had found opportunities for good work and had done it. At the present time, as compared with the newer applications of electricity, the telephonic field appears restricted, with most of its once "burning questions" disposed of; yet on closer inspection, it is clear that new problems arise every year for solution, and must be met.

THE passage of the electric launch "Volta" across the English Channel and back has naturally caused considerable comment, more perhaps on account of the novelty of the trip than the length, for as our columns have recently shown, the "Volta" has undergone a number of tests to prove the capacity of its accumulators, the source of power. A leading New York morning paper seems to look upon this performance as "the first practical application of electricity to navigation," and advances the opinion that "the electric motor is thus far, after some years of experiment, an interesting and expensive scientific toy, and there is no reason to expect that it will very soon become anything else." Our contemporary seems entirely forgetful of the fact that several electric launches are in use at the present time and that half a dozen electric railways are in daily operation in this country, and in some instances have been working for many months, not to mention foreign ones that date their existence back several years. Regarding other applications of electric motors, statistics show that about 5,000 are employed in this country alone for almost every conceivable kind of work. If our contemporary will take the trouble to investigate, it will only have to go one hundred yards from its office to find electric motors, in various places, running three floors of a machine shop, hoisting elevators, and so on. Our contemporary has evidently mistaken the object sought to be demonstrated by the trip of the "Volta." This was not to test the electric motor, which has passed far beyond the stage of experiment, but was designed to show the practicability of the use of storage batteries as a source of power for extended distances on water, and as such it has proved eminently satisfactory. We hope that, for its own satisfaction, our contemporary may find time to convince itself, by actual inspection, of the fact that the electric motor is something more than an "interesting scientific toy." It can hardly be a toy when one type of motor alone is running to-day in nearly fifty American towns and cities, and when one city of moderate size—Detroit—has no fewer than four electric railways built or building, within a radius of about five miles.

Another Western Union Dividend Passed.

The directors of the Western Union Telegraph Company met on Sept. 8, and decided not to pay any dividend for the quarter to end with the current month. The report signed by President Green laments "the great amount of business being done between the large commercial centres without profit, if not at absolute loss." For the first time in a quarterly report mention is made of the ocean cable business. As Gould caused the Western Union to lease his two cables at a yearly rental of $700,000 (five per cent. on the capital of $14,000,000), the company is necessarily losing very heavily on this contract, the revenue derived from cable service at present rates being insignificant. Dr. Green, imitating the cool confidence recently displayed by one of the cable companies in London, writes that "the cable business under the prevailing low rate has increased largely, and it is confidently hoped that the business will soon reach a volume that will yield a revenue equal to any ever before earned." Needless to say, no figures are given to back up this statement.

The corrected figures issued show that the earnings for the quarter ended June 30 fell $96,120 below the estimate published at that time. According to the statement "the net revenues of the quarter ending Sept. 30 inst., based upon nearly completed returns for July, partial returns for August and estimating the business for September, will be about $1,200,000." The items in this "estimated" statement compare as follows with those of the "estimated" statement for the corresponding quarter of last year:

Net revenue	$1,200,000	Dec. $250,000
Interest and sinking fund	143,615	Dec. 153
Balance	$1,056,485	Dec. $249,837
Dividend		Dec. 1,199,842
Balance	$1,056,485	Inc. $950,095
Surplus, July 1	4,309,833	Dec. 14,171
Surplus, Oct. 1	$5,366,318	Inc. $935,924

Compared with the corresponding quarter of 1884, the estimated net revenue shows a decrease of $500,000. The "surplus, Oct. 1," in the statement, says the New York *Herald*, is only "book-keeping," not cash.

Meeting of the Electrical Section of the American Institute.

The first meeting of the Electrical Section of the American Institute, formerly the New York Electrical Society, was held at Clinton Hall on the evening of Sept. 8, and drew forth a large attendance of members.

The paper announced for the evening was read by Mr. J. J. Ghegan, of Newark, N. J., who described a most ingenious and practical method of giving an alarm for low water in steam boilers by means of electricity. Mr. Ghegan was led to the construction of his apparatus by the reading of a note in a leading mechanical journal, stating the necessity which existed for a simple, reliable device adapted to the purpose. Having observed the disadvantages and inconvenience attending the use of the devices employed at present for the purpose, Mr. Ghegan set out to remedy them by designing a simple apparatus which should be placed outside the boiler so as to be accessible for examination at all times, and which, paradoxical as it may seem, should give its indications without mechanical or electrical connection with the boiler, as such.

The instrument he designed for that purpose depends for its operation upon the action of induced magnetism, in connection with the well-known fact that the action of the magnetic force is not impeded by the interposition of non-magnetic substances.

The accompanying illustration, Fig. 1, shows the instrument complete as it is attached to the water-gauge. Figs. 2 and 3 show a rear view of the device with the cover removed.

As will be seen, it consists of a brass case *C*, which is attached to one of the side rods *B* of the water-gauge of a boiler. Through the upper and lower end of the brass case there pass the legs of a horse-shoe magnet *M*, the ends of which project a trifle beyond the glass tube *A*. The case, which can be adjusted to any desired height, is so placed that the upper leg of the magnet shall come opposite the float *F* when the water is at its normal height. The float consists of a short piece of iron covered with rubber and vulcanized at a high heat.

Within the case there is pivoted the strip of iron *I*, which carries at its centre a platinum pin, *D*, and attached to the inside of the insulating cover *G* is a small platinum contact *E*. The latter is connected to the binding-post upon the cover, and another binding-post is in electrical connection with the brass case *C*; to both these are attached the wires having a battery and call-bell in circuit.

The action of the little instrument will now be readily understood. So long as the water remains at its proper level, the iron, being temporarily converted into a magnet by its proximity to the pole of the magnet, *M*, attracts the upper end of the iron strip within the case and maintains the pin *D* out of contact with the electrode *E*. When the water sinks, however, so that the float comes opposite the lower leg of the magnet, the iron in the float attracts the lower end of the iron strip against the wall of the brass case, and at the same time brings the pin *I* in contact with *E*. This closes the electric circuit and rings the bell to give warning of the fact. When the water rises the float follows and opens the circuit again.

Mr. Ghegan added, that having a way of closing an electric circuit at the proper time, we are thereby enabled not only to ring a bell, but also to operate any suitable electrical or electro-mechanical device. With the circuit-controlling apparatus just described it is entirely practicable to automatically keep the boiler properly supplied with water. All that would be necessary is the addition into the circuit of a magnet which should open a valve and start the pump when the circuit is closed; and when the float with the water rises to its proper level the opening of the circuit would be followed by the closing of the valve.

The instrument described by Mr. Ghegan was passed

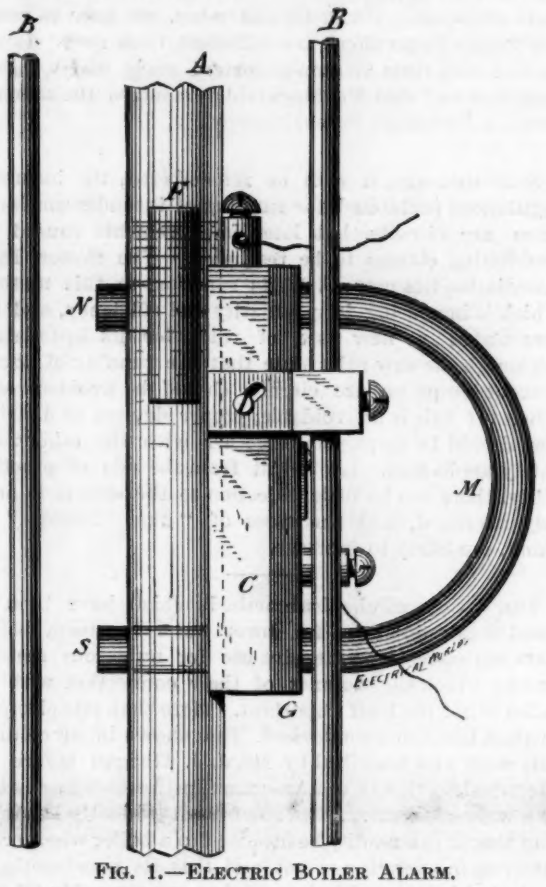
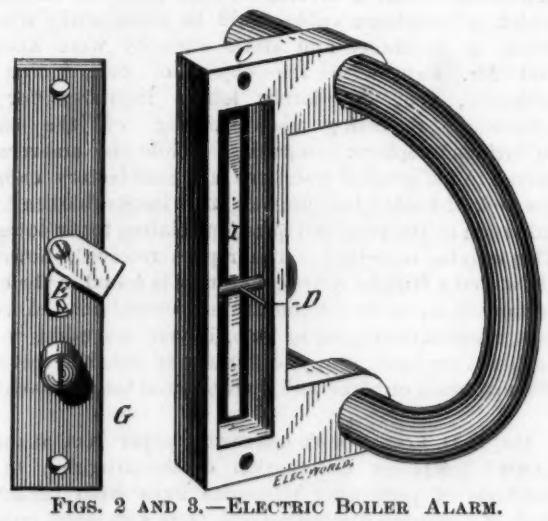


FIG. 1.—ELECTRIC BOILER ALARM.

around among the members and evoked much favorable comment.

A model of the apparatus was shown in operation, and its unfailing action elicited general admiration among those present.

After the reading of, and short discussion on, Mr. Ghegan's paper, Mr. Geo. W. Mansfield exhibited the brass plaque upon which the features of a young lady were portrayed, and produced, it is said, by the reflection due to a flash of lightning. Mr. Mansfield drew a diagram on the blackboard illustrating, as near as could be ascertained,



FIGS. 2 AND 3.—ELECTRIC BOILER ALARM.

the relative position of the window and surroundings and gave his theory of the manner in which the picture might have been produced by reflection from the window panes.

Mr. C. O. Mailloux, Mr. J. M. Pendleton and others gave analogous explanations which, however, were called into question by Dr. Vander Weyde and Dr. Mason, an old photographer. The former claimed that such a picture could not be produced by reflection from a flat surface, such as a window pane, which could only diffuse light. He was of the opinion that the picture had been produced by other means than the one originally suggested.

Mr. Mansfield, to whose custody the plaque had been confided by the owner, vouched for its genuineness, and the generally expressed opinion of those present seemed to be that it would be profitable to pursue the investigation and, if possible, reproduce the phenomenon by artificial means on the supposition of its electric origin.

Peltier's Phenomenon in Liquids.

BY E. NACCARI AND A. BATTELLI.

Two glass cylinders, 16 centim. in width, were placed near each other in a vessel of water, and a paper disc fastened in each, half way up. At the bottom of each cylinder was a copper disc 13 centim. in diameter. A solution of blue vitriol was poured in up to the disc, and on this a solution of zinc sulphate; in each of these solutions a zinc plate perforated in the centre was suspended. Both zinc plates were connected by a copper wire and a current passed through the apparatus, the intensity of which was determined by a reflecting galvanometer, one division of the scale of which represented an ampère. A very thin perforated glass plate was brought in the centre of each of the paper discs. In this aperture was accurately fitted the bulb of a thermometer, which was surrounded by a caoutchouc tube as far as the part in the aperture. The current of one or two Bunsen elements was sent through the apparatus in either direction, and the course of the thermometer observed every minute. If i and i_1 are the intensities of the current, y and y_1 the corresponding thermal effects, the magnitude of the Peltier phenomenon is given by the formula:

$$h = (yi_1^2 - yi^2) \times (ii_1^2 + i_1 i^2).$$

Only those experiments were taken into consideration in which i and i_1 were not greatly different from each other. With the following intensities were obtained:

i	63	123	148	187
$10^6 h$	71	64	72	67

The value of h is, therefore, almost independent of i, and thus Peltier's phenomenon is proportional to the intensity of the current.

When solutions of Glauber's salts of various concentration were superposed on each other, and the bulb of the thermometer was not at the surface of separation of the liquids, or if the same liquid was above and below the diaphragm, no appreciable value was obtained for h, so that the above results are not limited by other influences of heat.

If the entire apparatus was filled with water, and the thermometer was surrounded by a semicircle which was half of iron and half of zinc wire, and the current was passed through, the mean of ten experiments was found to be $h = 18$; so that the Peltier phenomenon between liquids is not of a less order of magnitude than between metals. As, according to Bellati, the electromotive force between zinc and iron is 0·0024 volts, the absolute value of Peltier's phenomenon may be calculated from this for the liquids investigated.—*Phil. Mag.*

Bernstein's New Filament.

Mr. Alexander Bernstein has succeeded in producing a carbon filament by a novel and interesting process. He takes a vessel containing a liquid hydro-carbon or some other carbon compound, such as the bisulphide. In this liquid he suspends a fine metallic wire while a copper plate is placed at the bottom of the vessel. He then passes a current through the liquid from the wire to the plate. This determines the decomposition of the hydro-carbon and the growth of a hard and dense deposit of carbon upon the end of the wire. By means of a clockwork attachment, the wire is gradually withdrawn at a suitable rate of motion, and in this way a filament of any desired length can be obtained. The cross-section of the deposit is regulated by adjusting the strength of the current and the size of the wire. By employing two wires as electrodes, and an alternating instead of a continuous current, two filaments are produced at one operation. One would imagine that the process might be carried out upon a large scale by employing a sufficiently large current and grouping the filaments in parallel.

Spongy-Carbon for Primary and Secondary Batteries.

Ordinary carbon, such as is used in batteries, is not as porous as is generally supposed, and the electrolytic action occurs almost entirely on its surface, or just below the surface. Liquids poured on ordinary carbon are not sucked in very quickly, which also proves that its porosity is very limited. Taking these facts into consideration, Mr. Emil Berliner, of Washington, well known in connection with the carbon microphone, has sought to remedy the evil by subjecting the carbon to a red heat with free access of the air. When thus partially burned, the carbon becomes extremely porous, and will then suck up liquids with avidity, like common porous earthenware.

According to Mr. Berliner, the porosity is produced by the heat driving off first the lighter hydro-carbons of the carbon piece heated, while the harder particles remain as a highly capillary mass. Such a carbon presents a large surface to electrolytic action, decreases the resistance and improves the depolarizing action.

Mr. Berliner who has recently patented this method of improving the quality of carbons, states that two such spongy carbons immersed in acidulated water form a very efficient secondary element, because a large amount of hydrogen and oxygen gas can be occluded in their pores.

But it is in secondary elements, employing the salts or oxides of lead, that spongy-carbon finds an important application. For this purpose Mr. Berliner soaks two spongy-

carbons in a cold saturated solution of lead salts, such as the acetate or nitrate. The two electrodes so charged with the salt are dried and immersed in acidulated water, and a current passed through them. The salts are thus transformed into the peroxide and the sulphate of lead.

Another method employed consists in immersing two dry spongy-carbon electrodes in a solution of acetate or nitrate of lead, or a mixture of both, in combination with sulphuric acid; these are then charged by a current which deposits the sulphate and peroxide in the two carbon electrodes, respectively.

The Engine Room of the Brush Station at Cleveland.

In our issue of Aug. 28, we illustrated the large dynamo room of the Brush Electric Light and Power Company, of Cleveland, O., which contains the dynamos having a capacity of 1,200 arc lights. This station, of which Mr. Henry E. Cooke is the superintendent, is situated most favorably in regard to the attainment of high economy in power generation. The engine room now illustrated in the accompanying engraving was designed with great care.

Of the engines in use, five in number, the largest is a Reynolds-Corliss, built by Messrs. E. P. Allis & Co., of Milwaukee, Wis. This engine, shown in the foreground, is 24 × 48 inch, and is capable of developing 330 horse-power.

In the construction of this engine great care has been bestowed upon the regulating mechanism, which is entirely independent of the valve gear. In this way very little power is consumed for regulation, and the sensitiveness of the mechanism is greatly increased. The valves are simple cast-iron blocks, cylindrical in form, requiring no springs to hold them in place, and are driven from one end by simple T-heads formed on the inner ends of the valve stems. With this construction there is nothing inside of the steam chests but the valves themselves, each composed of one piece of iron only. By removing the back bonnet, any one of the valves may be taken out without disturbing any adjustment of the valve gear.

Next in size to this engine come two built by Wright, of Newburgh, with automatic cut-off, and developing respectively 200 and 100 horse-power. Besides these, there are two high-speed engines from the Ball Engine Company, of Erie, Pa., each of 50 horse-power.

The principal bearings of all the engines are, like those of the dynamos, supplied with a continuous stream of oil by a system of piping, in which the oil is constantly circulated. The engines are all belted to shafting, upon which are mounted friction clutch pulleys which can be thrown in and out of service from the dynamo floor above.

The "Regent" Primary Battery.

The distinguishing feature of this battery are the means employed for obviating the necessity of repeated amalgamation of the zincs. Mr. Maquay, the inventor, avoids this by amalgamating his zincs throughout the mass, that is, by casting them from an amalgam of zinc and mercury. This has been tried before, that is, mercury has been added to the metal in the ladle, but without much success, as most of the former metal was evaporated before the castings had set. Mr. Maquay, however, forms a preliminary amalgam with another metal, such as lead or tin, and then he adds this amalgam to the zinc, the result being that he gets a perfectly homogeneous mixture or alloy in which the three metals are uniformly diffused throughout the mass. Consequently every particle of zinc is amalgamated, and as the plate gradually dissolves there is always a clean surface presented to the acid.

The reduction of local action involves a reduction in the amount of hydrogen evolved, and consequently in the tendency to polarization. In the Regent battery the electromotive force is said to remain practically constant for many hours. In an experiment made by Professor J. A. Fleming on a cell measuring 5 in. by 3¼ in. by 1¼ in., the current strength only fell 4½ per cent. in five hours. The internal resistance of the cell was .260 ohm, and the external resistance .845 ohm, the current strength being 1.75 ampères. The consumption of the zinc plate was 12 grammes, or at the rate of 2.2 lbs. per 1,000 watt-hours. When the cell was allowed to stand inactive, it was found that the zinc plate wasted at the rate of ½ per cent. per hour. As a matter of ordinary practice, a battery can be run about ten hours, after which the solutions require to be renewed. Several ways have been already devised for emptying and filling cells by simply turning one tap to discharge the spent fluid, and by opening a second to replace it with a fresh quantity, and it would be an easy matter to scheme a dozen more.

A Practical Use of the Microphone.*

In the summer of 1878, the author says that he was at the town of Canton in the eastern part of the State of Ohio, and that he was told by a person concerned that the main conduit, which brought the water from the lake about three miles off to the town, leaked, without their being able hitherto to ascertain where the faulty place was. The conduit was a clay pipe of about 24 in , and lay about 2m. deep underground in a gravelly soil, through which the issuing water trickled and never rose to the surface. The only way to ascertain where the faulty place was, appeared to be to dig at different places till they found it.

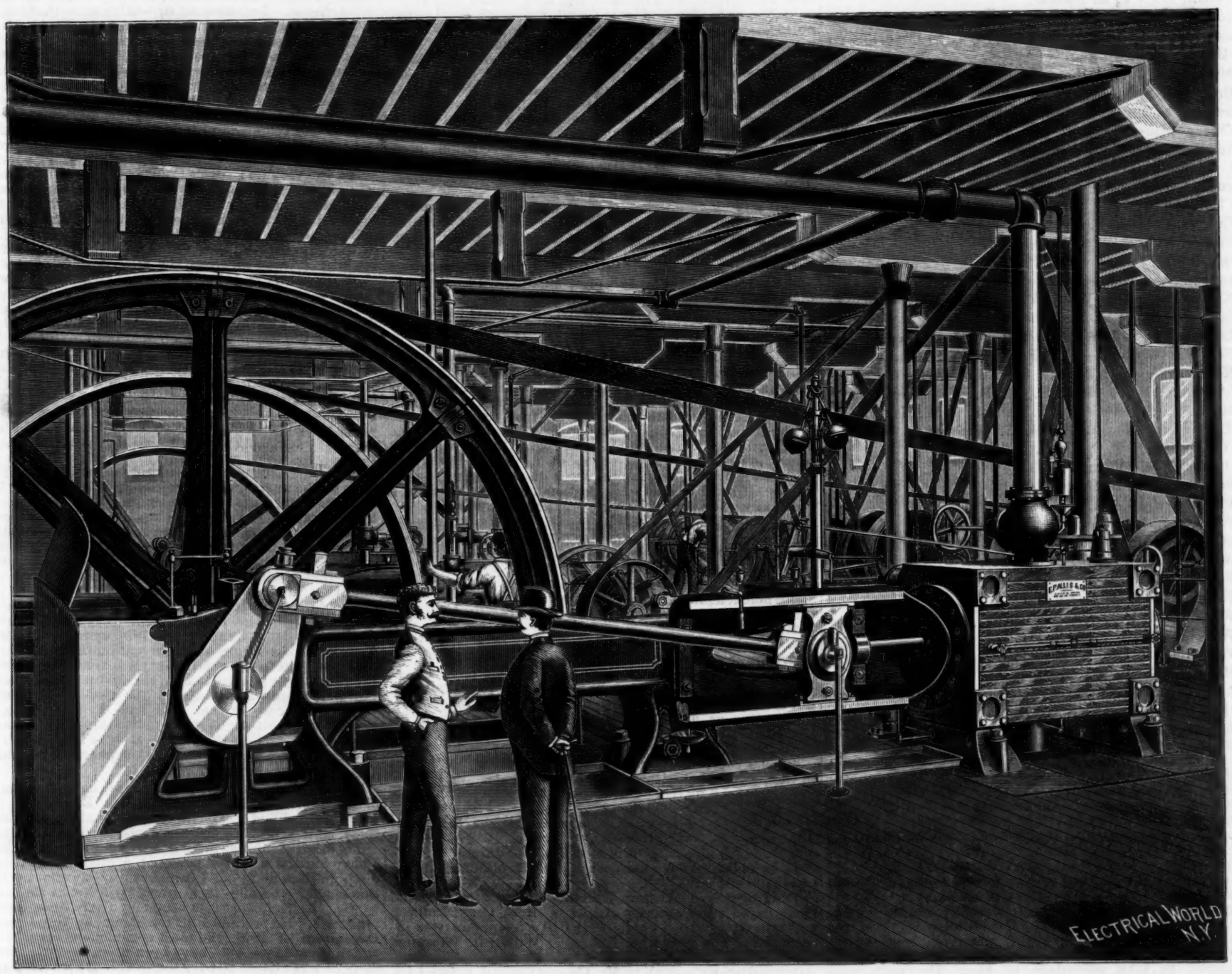
The author, however, proposed to observe the noise of the water by means of a microphone, while the conduit in question was closed at the end of exit in the pumping station, so that, if the conduit was in good condition, the water in it would be brought to a perfect stand-still, while he conjectured that above the place of leakage a sound of the motion of the water would be audible.

For that purpose he used a microphone similar to Hughes' disposition, mounted on a box open underneath and shut at the top by a sounding board. The microphone was in connection with the battery, induction coil and telephone, as usual.

After the water had been shut off in the pumping works at the town end, he began operations half-way between the lake and the town. A rushing noise was at once plainly heard in the telephone, which was at first attributed to the wind, but which remained unaltered after the microphone had been sheltered from the wind. The author had taken up a position with the telephone about 5m. on one side, while the microphone was directly over the water conduit.

To remove every doubt that the noise arose from the flowing of the water, the microphone was moved gradually farther from the conduit, when the noise became gradually less and less, and finally completely disappeared.

*By Ph. Seubel, in the *Centralblatt für Electrotechnik.*



ENGINE ROOM, BRUSH ELECTRIC LIGHT STATION, CLEVELAND, O.

Consequently it was clear that the leakage was nearer the town.

The observations were now continued at distances of 40 to 50m., and the noise remained constantly the same for some distance, till at last a sudden diminution in it was observed. Consequently the leak had been passed. The diminution of the noise signified on the author's conjecture a damming of the water. And here he was not mistaken, since the farther back again he went with the apparatus the louder the noise became. In this way he determined the point of leakage within less than 10m. On digging it up the conduit was found to be much damaged at the spot.

St. Louis Meeting of the National Telephone Exchange Association.

The eighth meeting of the National Telephone Exchange Association was held at the Southern Hotel, St. Louis, beginning Sept. 7, under the circumstances described in THE ELECTRICAL WORLD last week. The following is the list of those in attendance :

Albany, N. Y.—A. B. Uline.

Austin, Tex.—J. K. Dunbar.

Boston, Mass.—J. N. Keller, C. Jay French, T. D. Lockwood, Frank B. Knight, R. S. Boyd, T. B. Doolittle, W. A. Hovey, A. O. Morgan, G. Albree.

Bridgeport, Conn.—Henry D. Stanley.

Brooklyn, N. Y.—W. D. Sargent, T. J. Perrin.

Buffalo, N. Y.—E. J. Hall, Sr., H. C. Palmer.

Chicago, Ill.—C. N. Fay, C. A. Brown, J. M. Jackson, Fred. Degenhardt, W. A. Kreidler.

Cincinnati, O.—E. V. Cherry, H. T. Crane, H. L. French.

Cleveland, O.—J. P. McKinstry, G. H. Wadsworth.

Denver, Col.—E. B. Field.

Elmira, N. Y.—W. N. Eastabrook.

Harrisburg, Pa.—J. B. Ker.

Indianapolis, Ind.—J. E. Hockett, C. Wittenberg.

Kansas City, Mo.—Wiley W. Smith, C. W. McDaniel.

Louisville, Ky.—H. N. Gifford.

Lowell, Mass.—J. W. Bennett, Chas. J. Glidden.

New Haven, Conn.—H. P. Frost, W. C. Smith.

New York.—C. H. Barney, H. L. Storke, D. I. Carson, J. A. Seely, E. J. Hall, Jr., C. B. Hotchkiss, W. A. Childs, Frank Shaw, Geo. T. Manson, F. W. Harrington, C. C. Jennings, Geo. L. Beetle, C. W. Price, R. W. Ryan, T. C. Martin, E. T. Gilliland.

Omaha, Neb.—Flemon Drake.

Peoria, Ill.—T. B. Burnett.

Petersburg, Ill.—C. D. Wright.

Pittsburgh, Pa.—Henry Metzger.

St. Louis, Mo.—Geo. F. Durant, D. R. Russell, P. C. Burns, E. A. Hitchcock, B. R. Bates.

Salt Lake City, Utah.—C. F. Annett.

Topeka, Kans.—J. R. Mulvane.

Washington, D. C.—J. M. Brown.

Wheeling, W. Va.—M. R. Wolff.

Williamsport, Pa.—R. M. Bailey.

Montreal, Can.—C. P. Sclater.

At 11 a. m. the convention came to order, President C. N. Fay in the chair. Mr. Fay said :

It gives me great pleasure to call to order the eighth annual meeting of the National Telephone Exchange Association, and to wish for it and its members happiness and prosperity during the coming year. The outlook for general business is magnificent ; trade and labor troubles seem well-nigh ended. The triumph of the law over anarchy and socialism has been so heartily welcomed by the mass of our people that all men feel confident that these poisonous exotics have no firm root in American soil. This confidence has already been reflected in the unloosing of capital and the starting of the wheels of trade. Small stocks, coupled with low prices of all staples, a sound financial condition of the public treasury and of general business, sufficient crops, an active foreign demand for our exports, all point to an era of commercial prosperity and activity. The telephone companies of the country are prepared to take advantage of this. The past year has been a trying one. The city companies have to face enormous expense for underground lines. The companies doing country business have been compelled to carry out still further the process of closing and abandoning exchanges which have proved too small for self-support. City and country exchanges alike have suffered from legislative and municipal attacks upon their rates, and the whole business has been disturbed and unsettled by the government attacks on the Bell patents. Nevertheless, the upshot of it all is, that the American Bell Company and ourselves, the licensee companies, are still alive, still doing business, and we hope to grow in size and usefulness, strength and popularity, as time goes on. It is unquestionable that a wave of popular hostility, which some one has named telephomania, has swept over the country, directed against the telephone, perhaps because it is the most visible and tangible and everywhere localized of all monopolies. It is worth while to inquire with what justice we are thus attacked. Is it true that enormous fortunes have been made by franchises corruptly obtained, by stock waterings, and, to use the current phrase, by oppressing the people? Let us look broadly at the facts. The capital stock of the American Bell Telephone Company is $10,000,000, now selling in the market for $19,000,000. Of this amount the share-holders actually paid into the company's treasury in cash $6,000,000, showing their profit to date to be $13,000,000. The licensee companies throughout the country are capitalized at about $54,000,000, selling in the market to-day for not to exceed $25,000,000, an amount considerably below the actual money paid therefor, and below the actual cost of the plant and acquired business. There are undoubtedly individuals who, in the manipulation of telephone stocks, purchases and sales thereof, have made and retained considerable fortunes, but the broad fact remains that, say $15,000,000 would cover the entire amount of profit which the telephone fraternity have been enabled to exact from the suffering people during ten years of hard work and add to their investment of $30,000,000 of capital, say 5 per cent. per annum. On the basis of the last census this would be three cents per annum extorted from each of the suffering people aforesaid. As I look around this room and view this assemblage of "monopolists" and "extortioners" I do not see a single millionaire. I doubt if all of us together could muster that sum. I challenge the investigation of the industrial history of this generation to show an instance in any line of trade in which so large a business has been developed upon so small a margin of profit. Fortunes abound on every hand made in railroads, mills, mines, manufactories, breweries, groceries, dry-goods stores and the like, but no one grumbles; the unlucky telephone is made the scape-goat for the whole.

Another noteworthy fact is that the great mass of the people have, in the nature of things, nothing whatever to do with the telephone. With the time and expenditure aforesaid we have managed to put in use, say, 160,000 sets of telephones—that is, we have reached one-fourth of one per cent. of the population of the country (in our wildest dreams we cannot hope to reach more than one-half of one per cent.), and this minute fraction of the population is most emphatically, in every way, shape and manner, composed of the rich capitalist class. Telephone users are men whose business is so extended, and whose time is so valuable, as to demand rapid and universal local communication. A laborer who goes to his work with his dinner basket has no occasion to telephone home that he will be late to dinner ; the small householder, whose grocer lives just around the corner, would not pay one cent for a telephone wherewith to reach him : the villager, whose deliberate pace is never hurried, will walk every time the few steps necessary to see his neighbor in order to save a nickel. The telephone, like the telegraph, post-office and the railroad, is only on extraordinary occasions used or needed by the poor. It is demanded and daily depended upon, and should be liberally paid for, by the capitalist, mercantile and manufacturing classes.

This talk about oppressing the people is the merest rot. It is very true that every man would like to have a telephone if he could get one for nothing, but so would every man like to have horses and carriages, and good things to eat and drink and wear if he could get them for nothing; and the latter would be far more appreciated by the poor man than the telephone. If, therefore, the State must interfere to furnish luxuries cheap to all men, it had better begin with those things which would be most universally welcome.

This popular animosity, however unfounded, has culminated in the Indiana rate troubles and the Government attacks upon the Bell patents. Mr. Storke's able hands have prepared a report and discussion upon legislation. General Barney had hoped to obtain from Mr. Tompkins, of the American Bell, a paper upon the litigation of the year, failing in which (to his great regret) he has asked me to say at this time what I can about it. I have but a general and superficial acquaintance with the subject, and if I misstate shall be glad of correction, or if I omit will welcome any question which may expose the omission.

My résumé will be based on the recitals of the bill lately filed by the American Bell Company, at Chicago, vs. Cushman—the latest inventor of the telephone twenty years before Bell.

Perhaps it may be interesting to make a brief review of the whole telephone litigation from the beginning. Five kinds of defense have been set up by infringers of the Bell patents :

1. Priority of invention by others, especially Reis, McDonough and Gray.

2. That Bell did not invent the speaking telephone at all; that he intended to invent a multiple telegraph, and not a telephone; and that the machine he did invent was inoperative as a telephone until after he obtained his patent, and then worked only by the use of a liquid transmitter devised by Gray.

3. That there was a fraud in the issue of the Bell patent in the matter of the Gray caveat.

4. That as a matter of fact the undulatory current patented by Bell is not the only means of transmitting speech, but that a make-and-break current can be, and is in practice, employed therefor.

5. That the government is attacking the patent.

These defenses have been set up and adjudicated in the following cases :

The Dowd case (Western Union): Defenses set up—the Gray caveat; the priority claims of Reis, Gray, Dolbear and others; and the claim that Bell's telephone was inoperative. The action of Examiner Wilbur in reference to the Gray caveat was fully in evidence in this suit. After testimony was all in Mr. George Gifford, counsel for the Western Union, advised them to yield. They did so with the consent of Gray, and a decree was entered in favor of Bell by consent in April, 1881.

Spencer and Eaton cases: Decided in June, 1881, by Judge Lowell in Boston and Judge Wheeler in New York. Defenses set up—the inventions of Reis and others, and the claim that Bell's telephone was inoperative. In these cases the judges decided that Reis had not invented a speaking telephone, nor any method of transmitting speech electrically. That the Bell telephone constructed according to the original patent would talk, and that a carbon transmitter infringed upon that patent.

Dolbear case : Preliminary injunction granted by Mr. Justice Gray Jan. 24, 1883, and finally decided by Judge Lowell June 30, 1883. Defenses set up—priority claims of Reis and other inventors, and the proposition that the undulatory current was a natural phenomenon and not patentable. In this case the Reis defence was most elaborately presented. His instruments were tested in court and failed to transmit speech. Judges decided that the method of transmission by an undulatory current was patentable, and fully described in the Bell patent.

Drawbaugh case : Preliminary injunction granted by Judge Blatchford in New York Nov. 18, 1880. Defenses set up—Gray caveat ; priority of Gray, Edison and Drawbaugh, especially the latter; Bell's telephone was inoperative; Bell had stolen Gray's liquid transmitter. In this case Bell was cross-examined for three weeks. Judgment rendered for Bell by Judge Wallace in December, 1884.

Ghegan and Hopkins cases (People's Telephone Company): Defenses set up—priority of Reis, McDonough, Drawbaugh and others. Decided in New Jersey by Judge Nixon, and in New York by Judge Wallace, in December, 1885.

Overland cases : In New York, New Jersey, Pennsylvania, Kentucky and Ohio. Defenses set up included all the evidence in the Dowd case, Spencer case, Drawbaugh case ; priority of Reis, McDonough and Vander Weyde, Gray caveat, and that prior decrees were obtained by collusion. These cases were hung up by Judge McKennon on motion for preliminary injunction at Philadelphia pending the issue of the Drawbaugh case. As soon as that was decided, permanent injunction was granted by Judge Butler and Judge Nixon, in January, 1885, which was followed by injunctions in all the other States mentioned.

Molecular cases : Judge Wallace's injunction granted in June, 1885. Defenses set up—priority of Reis, Vander Weyde, Holcomb and Beardsley; priority and caveat of Gray ; attempt to demonstrate that the Reis telephone would talk, that Bell's telephone was inoperative, and that an intermittent current was used. The Molecular Company was also stopped in Ohio by Mr. Justice Mathews and Judge Walker.

Clay case : Decided by Judge McKennon in April, 1886. Defenses set up—that Bell's original telephone could not talk ; that Bell invented the telephone after his patent had issued; that he actually used an intermittent current; and likewise the priority of Reis. After the argument and before decision had been announced they asked that the case be continued to wait the result of the government suit to cancel the Bell patent. This request was refused by the judges, and decision rendered.

Pittsburgh case (National Improved, or Rogers Telephone): Decided in December, 1885, by Judges McKennon and Acheson. Defenses set up—same as in the Gray case.

New Orleans case (National Improved): Decided in May, 1886, by Judges Pardee and Billings. Prior to the argument in this case the proceedings before the Secretary of the Interior, instituted by the Pan-Electric people, had attracted the attention of the entire country, and allegations were made broadcast in the press that Gray had been defrauded ; that Bell's patent was illegally obtained ; that bribery had been committed; that the original decisions in the telephone litigations were obtained by collusion, and that all succeeding decisions had followed by comity between the various District Courts in the United States. In other words, that no telephone case had been tried and decided fairly on its own merits. The anti-monopoly feeling was used to its utmost to prejudice the country against the Bell telephone. Defenses set up—all the defenses raised in the Pittsburgh case, particularly the priority of Reis, the alleged fraud on Gray, the alleged unfairness of previous decisions, and the necessity of awaiting the result of the government suit, and all grounds of attack which have since been set out in bill of complaint in the government suit at Columbus. The defendants introduced in evidence all the testimony which had been exhibited by the Pan-Electric people before the Secretary of the Interior in November, 1885, together with several hundred more pages of evidence and two new affidavits from Elisha Gray. Oral arguments occupied twenty-one days, and printed arguments for the defense were filed several weeks later. The decision filed May 31, 1886, was of the very first importance. The court held that previous suits were honestly defended, not collusive, and ought to be followed in this case; but, that there might be no question in future as to the fairness of the decision in this case, the judges had determined not to rest upon the decrees in other cases, but to examine the questions *de nove*. They declined first of all to defer decision in this case until the conclusion of the government suit; they found that Bell invented the method of transmission of speech by an undulatory current; that his invention was fully set forth in his patent; and that his instrument, made according to the patent, would talk (in fact that the judges talked through those instruments in the open court). They found that Bell's application dated January 20, 1876, certainly anticipated Gray's first disclosure of his invention, February 11, 1876; and that therefore, even if Gray's invention had been unlawfully made known to Bell, it could not have prevailed; but that there was nothing in the evidence to show that this was the case, or that Bell had done anything inconsistent with his right to be called an honest man with clean hands. That Reis' method was based upon an intermittent current, and that his telephone would not talk. Injunction was granted.

The telephone litigation, in a word, has been one series of triumphs for Alexander Graham Bell, each victory more unqualified than the last. Finally, as is just and right, comes this New Orleans decision with its magnificent vindication of him as an "honest man with clean hands." I have but the slightest personal acquaintance with that distinguished man, but I can sincerely say that nothing in this masterly opinion so warmed my heart as those simple words. Bell's history has been singularly open these past ten years. He produced his telephone at the Centennial Exhibition of 1876, the most conspicuous occasion upon which it could possibly have been brought out. Immediately he was known all over the world. He traveled and lectured through the East—in England, France and Germany. Everywhere he was welcomed and recognized as the originator of a truly great invention. He was made one of the fifty members of the American Academy of Sciences ; he was made an honorary member of learned and scientific bodies in England and on the continent ; degrees were conferred on him by the great universities here and in England and Scotland ; France gave him, at the hand of its great academy, the Volta prize of 50,000 francs, instituted by Napoleon the Great, for discoveries of transcendant interest in electricity, a prize not before given for generations. All foreign countries gave him their patents, except where publication in America had under their laws forestalled him.

Their courts have defended those patents. In America, two justices of the Supreme Court, five judges of the Circuit, and seven judges of the District Courts of the United States, in thirteen stubbornly contested cases, conducted by the first lawyers of the land, in eight different States, at an expense of nearly a million dollars, upon thirty thousand pages of testimony, have for ten years steadily pronounced in his favor. Meantime, what has he been doing? A scientific man to the core, he made over to his wife, his parents, his father-in-law, the great property derived from his patents, and placidly returned to his first love, the education of deaf mutes. Now and then, just to keep his hand in as it were, he brings out such brilliant conceptions as his photophone, or his more recent apparatus for photographing sound. In this honorable retirement, amid all these honors and emoluments, this concensus of the applause of all that is disinterested, scientific, learned and just, it has been reserved for sharpers who fleece the public with "bogus" telephone stocks; for Wilbur, who sells affidavits on both sides for $100 apiece as called for; for Gray, who swears in open court that he

once swore the other way because he then thought it his interest; for the daily press in its customary haste to reproduce the sensational; for—alas that it must be said!—the present administration at Washington: it was reserved, I say, for this strangely assorted crew to villify and slander him. But now comes Judge Pardee and says he is an "honest man with clean hands." "Well," say the Pan-Electricians, "Judge Pardee has been bought. Bell was a poor man once, did not have a dollar, but he began and bought the Patent Office, bought the Western Union and Elisha Gray, and Drawbaugh, and Dolbear, and Judge Lowell, and Justice Gray, and all the other judges from Massachusetts to Texas. He bought the American Academy and the French Academy, the jury that awarded the Volta prize, winding up the other day with all the great university of Heidelberg, and now he is rich." You may ask why did not the Pan-Electricians do the same? They have tried it, and have bagged a few politicians, but so far not a single judge. So much the worse showing for them and their story.

What an extraordinary spectacle is the history of bogus telephony; what a procession of magnificent gas-bags! Look at them: The Dolbear Company, capital $1,000,000; Eaton Company, capital $1,000,000; People's Company, parent capital $3,000,000; sub-companies all over America, capitals from $500,000 up, that for New York, New Jersey and Pennsylvania alone being $15,000,000; the Overland Company, capital $5,000,000; sub-companies everywhere with capitals from $500,000 up; the Molecular Company, the Clay Company, the Hopkins Company, the Home Company, the Meucci Company and fifty others whose capital I know not; the Pan-Electric, parent capital $5,000,000, sub-companies all over the country; and last, as far as heard from, not least Gray's New Company, capital $10,000,000. Where are these companies' telephones, their wires, their exchanges, their subscribers, their acquired business? Where is anything to attest their existence except worthless stock certificates, disastrous law suits, and now and then the damaged name of a politician? In the piping times of Drawbaugh, the American Bell Telephone Company, possessing absolute ownership of over half of all the telephone business in the country and an income from royalties and dividends of $2,000,000 a year, was selling in the market for $15,000.000. The Drawbaugh Company, without a pole or a wire, or any property of any description, except the right to defend law suits, was capitalized for three States at only $15.000,000.00; but its prospectus bore on its title page, in its largest type, the name of George F. Edmunds, and rightly enough, for this was its sole salable asset. The United States Company rejoiced in the name of Roscoe Conkling. The Pan-Electric—but why speak of the Pan-Electric? Already the bucolic Garland has pleaded the baby act in open court, and swears by all that is good and holy that if the judge will only let him off this time he will give up his plunder and never get into such a scrape again. How little he thought when taking in his Pan-Electric dividends that this pleasant little game of selling worthless trash to the innocent and ignorant on the strength of his name would become tiresome so soon. However, it is always true that statesmen must be educated at the public cost, and his education is progressing. The next telephone sharper who offers him a half a million in stock for the use of his name will probably conclude that he has run against a dynamite bomb. In like manner Gen. Joe Johnston, who feared that people might call him a swindler, and Senator Harris, who apparently did not trouble himself about such things, will have their ideas of personal responsibility wonderfully clarified if a few of their victims sue them upon worthless certificates bought on the strength of their names. As for the President, it is almost inevitable that the government suit should share the fate of its predecessors, in which event the Detroit *Free Press* will probably construct for him one of those delicious dialogues with Dan. Lamont, of which it is so fond. Something like the following:

Time, next summer; scene, the Adirondacks. President speaks:

"Daniel, how is it that the telephone suit has gone against us?"

"I cannot tell, sire. We did all we could to stack the cards. We hired Thurman and Lowery and John Goode and all the other Pan-Electric lawyers; and we brought the suit before Judge Baxter, who was considered the worst patent smasher in America; then when he died we appointed Senator Harris' colleague, a good Tennesseean, who we hoped would stand by us every time; but the confounded Supreme Court was too much for us. They are all Republicans, and the telephone cases up there were so far along that we could not stop them."

"Well, Daniel, is not this decision a severe reflection on the Pan-Electric section of our party?"

"It is, sire."

"How came it, Daniel, that Mr. Garland was such a guileless fool as to get into that nasty stock swindling enterprise?"

"He was poor, sire, and green. He had not cut his eye teeth. His financial experience, he said, had been limited to law and poker."

"But how came Mr. Lamar, who is said to be a lawyer, to commit the government to such a risky suit in the face of all previous decisions?"

"He felt compelled to endeavor to whitewash Mr. Garland, sire, and he thought the suit would please the people, because Bell's telephone is a monopoly and unpopular."

"But, Daniel, did not Gray and the other opponents of Bell also desire a monopoly to be set up by themselves in the room of Bell?"

"They did, sire. It was dog eat dog."

"If they had succeeded, Daniel, would not the government probably have been called on by its speculative friends to attack all valuable patents in like manner at its own expense?"

"I think it would, sire."

"Would not this ruin the value of all patents, and eventually break down our patent system?"

"That can hardly be doubted, sire."

"Is such a result desirable, Daniel?"

"No, sire. All civilized nations maintain patent systems as conducive to national prosperity, and our American patent system has been held up as a model for the world."

"Then, Daniel, with all these facts before me, how come I, even I, a well-meaning President, to be such an inspired idiot as to become the tool of stock-sharpers, spending the people's money in a hopeless suit, helping one set of monopolists against another, to the establishment of an ev. precedent, the disgrace of my Cabinet, and the discomfiture of my Mugwump friends?"

"God only knows, sire. He can understand both the wisdom and the foolishness of man."

"Daniel, if in the inscrutable dispensation of an all-wise Providence it should ever be my lot to enjoy the unspeakable happiness of a second term, I will never do this thing again."

"Amen, sire."

"Daniel, d—n the telephone, anyhow."

But at this juncture Daniel rang his chestnut bell, and the conversation ended.

Pardon me, gentlemen of the association, if this little allegory seems flippant or unworthy its occasion or its subject. Both are serious enough and deserve serious treatment at abler hands than mine. It embodies my convictions, and a little ridicule often goes farther than a sermon to illuminate the mischief and folly of letting politics interfere with justice.

After the president had read his address, Secretary Barney presented his report, reviewing ably the work of his department as now conducted. It summarized also the treasurer's report:

The election of officers was next proceeded with. Mr. C. N. Fay was re-elected President; Mr. Henry Metzger was elected Vice-President; Mr. H. L. Storke was re-elected Treasurer, and General Barney, Secretary. Mr. H. N. Gifford was elected as the new member of the Advisory Committee. The new Executive Committee selected was: Messrs. W. D. Sargent, R. M. Bailey, G. M. Stone and J. N. Keller.

On motion of Mr. Metzger, Pittsburgh was chosen as the place of next year's meeting, time to be left to the decision of the Executive Committee, with the understanding that it would be well to make it later in the year.

Dr. C. Lemon, Superintendent of Government Posts and Telegraphs, Wellington, New Zealand, was elected to honorary membership.

CONSTITUTIONAL AMENDMENTS.

The next business was the consideration of amendments to the Constitution and By-Laws. As adopted, after prolonged discussion, the readings are as follows, the new portions being italicized:

"ARTICLE IV. Section 1.—The officers of this Association shall be a President, Vice-President, Secretary, Treasurer, and an Executive and Advisory Committee, who shall, with the exception of *the Secretary and* the members of the Advisory Committee, be elected at each annual meeting of this Association, and shall hold office for one year, or until their successors are duly elected and qualified. *The Secretary shall be appointed, for the ensuing year, by the newly-elected Executive Committee.*" (Proposed by the Executive Committee.)

"ARTICLE XIV. Section 1.—The admission fee shall in all cases be ten dollars, to be paid on signing the Constitution. The annual dues shall be *fifty* dollars for each vote now had or that may be hereafter acquired under the Constitution, and shall be payable on or before the 1st day of October in each year, for the year ending August 31 thereafter in each year." (Proposed by the Executive Committee.)

ARTICLE XVII. Section 1.—"*Any person nominated by the Executive Committee may become an honorary member of this Association by a vote of two-thirds of all the members present at any regular meeting, such election to be by ballot.*" (Proposed by Mr. E. J. Hall, Jr.)

ARTICLE XVIII. (Additional Article.) Section 1.—"*Any person or corporation actively interested in the objects of this Association may become an associate member of the Association by a vote of a majority of the members present at any regular meeting.*

Section 2.—"*An associate member shall have no vote in the meetings of the Association, but shall be entitled to all the other privileges of regular members, except during executive sessions, and shall be subject to the same dues and assessments.*" (Proposed by Mr. E. J. Hall, Jr.)

The following change in the By-Laws proposed at the 1885 meeting by Mr. H. L. Storke next came up for action. It is an additional section to Article III.:

Section 5. *The secretary shall, under the direction of the Executive Committee, procure and compile for the use of the Association such statistics relating to the telephone business as have heretofore been furnished by the various committees of this Association.*"

It was adopted.

The discussion on the above amendments occupied a large part of the morning session and the opening hour of the afternoon session.

Gen. Barney then read a paper on

EXCHANGE STATISTICS.

This paper was a continuation of the work done by the old committee on exchange statistics. Reports were embraced and analyzed from 46 exchanges, representing 47,000 subscribers, these reports being made by 21 companies. It appeared that Detroit was the city best supplied with telephones, there being one station to every 51 inhabitants. Providence comes next with one to every 58. Jersey City has only one to every 232 of her population. "Taking the fourteen exchanges which reported last year and this, we find that the daily connections have increased from 173,335 to 207,892—an increase of 34,557, or 20 per cent. This only shows what is well known to every telephone man, that the number of connections increases in a greater ratio than the number of subscribers, generally speaking. This rule, however, does not seem to hold good in all cases, inasmuch as New York, which has added 791 new subscribers, only makes 3,500 more daily connections than last year, and Chicago, with a gain of 437, only increases its connections 1,628 daily. But Brooklyn, which has increased its list of subscribers 19 per cent., gains 35 per cent. in the number of connections made, and Detroit, which has gained 17 per cent. in subscribers, makes 50 per cent. more connections daily than in 1885. No exchange shows a falling off." * * * "As last year, the Detroit subscribers show the greatest appreciation of the telephone, and seem to use it still more than then. In 1885 their average was ten and six-tenths times daily; in 1886, it is thirteen and eight-tenths times. Boston, Brooklyn, Milwaukee, New Orleans, Pittsburgh and Washington returns indicate an increased use, while Baltimore, Buffalo, Denver, New York, Providence and Richmond show a falling off." * * * "The eight offices (reporting) working on the 'multiple' system average 623 connections per operator. The remaining fourteen, using 'straight' boards, average 309 connections per operator. Although New York, Denver, Pittsburgh and Providence are making less connections per operator than a year ago, it would appear that the majority of the exchanges are getting more work out of its operators than formerly. Remembering the discussion upon Mr. Carty's paper at the Providence meeting, as to the number of calls that could be answered by one operator in a day upon the multiple board, it is interesting to notice that New Orleans reports 1,054 as its operator's average day's work." Eight multiple boards average 81 wires per operator; fifteen straight boards average 65 wires per operator. The most noticeable feature in the table of direct and circuit wires, is the great preponderance of circuit wires in the New England exchanges. New York City has only 6 circuit wires; Chicago, none at all. Other figures were given, based on limited returns, as to trunk lines, operators' salaries, and other details.

Mr. T. D. Lockwood then read the following paper:

ON THE NECESSITY OF PROTECTING TELEPHONE EXCHANGES, CIRCUITS AND APPLIANCES FROM THE DESTRUCTIVE EFFECTS OF INTENSE ELECTRIC CURRENTS AND DISCHARGES.

In the younger days of telephony and telephonic utilization, when we *too* were younger, to write a paper or an article upon the intricacies of the telephone, the central office, the signaling and induction neutralizing appliances was for me an easy operation. I am sure that the majority of you will agree with me that it is a comparatively light undertaking to write an instructive article upon a subject of which we know little or nothing, and to dilate learnedly upon the causes, near or remote, of phenomena with which we only have a bowing acquaintance, but as we and our business grow older we grow more cautious about making assertions, and do not especially yearn to air our superficial knowledge; consequently when in the palmy days of telephony my pen was accustomed to scratch off from twelve to fourteen pages of foolscap per week, it was less of a task than it now is merely to choose a subject to write about, and when I occasionally throw a retrospective eye over the statements which unscrupulous publishers have ascribed to me, I rather wonder on the whole that I made so few mistakes. I hesitated considerably before consenting to commit myself to a paper for the Association, and when our honorable secretary asked me directly if I would furnish a paper, I am afraid that I only said "I would try," from a constitutional disability to say "No." Still we have it on the very highest authority—as General Butler would say—that "Fools rush in where angels fear to tread," and after long and painful cogitation, I chose the subject with the long title which I have read to you, principally, I grieve to say, for the lamentably insufficient reason that, upon looking over the association records, I found, or thought I found, that it was as unhackneyed as any I could pitch upon, unless I switched off from the realm of applied electricity into "methods of book-keeping—toll versus lump-charge," or some other of those lay investigations of which electricians and electrical engineers are supposed to know nothing.

I have in the title of my paper referred both to intense electric currents and discharges. It may be said that the terms "currents" and "discharges" are synonymous. And indeed the difference is only one of degree; but for the purpose of this paper I have assumed a current of electricity to be an electrical excitement in a linear conductor of comparatively controllable force, so that it is actually dependent for its existence upon a circuit of some sort, and which consequently ceases to be, when that circuit is broken or impaired.

Per contra: I choose to regard a "discharge," or more properly a "disruptive discharge," of electricity as a form of electrical excitement which is not dependent upon the palpable continuity of a circuit, and which, as in the lightning flash, has a sufficient force of its own to leap an air space or to traverse an extremely poor conductor which may intervene in its direct and devastating career.

There is, I hope, little need that I should emphasize the necessity of protecting our circuits and apparatus from the destructive effects of these currents and discharges.

It would not be hard for me to believe that every exchange represented at this meeting has directly or indirectly, in a greater or less degree, suffered from this cause. When the business was in its first and second years, we heard little of damage and loss, fairly to be ascribed to abnormal electrical currents and discharges. The electric light then existed only in a sporadic state. As recently as July 4, 1876, it was counted a startling novelty not to be repeated hastily, to show an arc light upon the Western Union New York tower; and we were just begining to hear of Brush, and to get a hazy idea that the Brush machine was so named, because possibly there were more brushes on its commutator than on the average machine: and that the Gramme machine owed its patronymic in some vague and unaccountable way to the centimetre-gramme-second system of units. Even the summer lightning storm scarcely seemed at that early time to have acquired the prevalency, fierceness and the ability of getting in its work, that it has assumed in late years. I imagine, however, that the immunity we then apparently enjoyed is to to be ascribed first of all to the small number of exchanges, circuits and telephones in existence, and the probability is that all things being equal, the mortality of telephonic appliances from this disease was not much less in proportion to the number of instruments in use than it is now. At that time, too, the battery transmitter was not so universally employed, and the magneto bell was not, therefore, so complicated in its switch connections, while the telephones, when not actually being used, were completely cut off from the circuit. By the end of 1881, however, we began to ascertain, by bitter experience, that throughout the United States (with the exception of the entire city of Philadelphia) lightning was a factor among the destructive agencies at work against telephone plants, which had to be counted upon. With respect to the remarkable exemption from disaster due to this cause enjoyed by Philadelphia, I am constrained, after careful consideration, to believe that it can only be ascribed to the existence of the same conditions which in ages gone by would have saved Sodom, to wit, the residence there of not less than ten righteous men. The destruction of telephone apparatus at this period was quite noticeable, and curiously enough, that portion of the apparatus which seemed to suffer the most heavily was the transmitter induction coil; and this seemed the more singular in view of the fact that this portion of the instrument was assumed to be in circuit only during the actual occurrence of conversation, and to be totally disconnected by the automatic switch during the long and frequent intervening periods

of quiescence. This was ultimately accounted for by the circumstance that the older magneto bells had but one binding screw for their local battery connection, and it was customary for the person connecting them to attach the other battery wire into one of the main line connection screws. This, of course, left one end of the primary helix of the transmitter coil always in connection with the line, and in the event of the line receiving a lightning discharge, a portion of it would frequently seek earth through the primary helix and across the insulation to the secondary, burning both out in transit. The practice of connecting the battery wires in this fashion was very generally discontinued after this discovery, and the bells later were differently arranged, so that this danger was subsequently minimized.

By the beginning of 1882, electric light plants were fairly established in most of our large cities, and from that time to the present they have been a constantly increasing quantity. Very few cities of any importance are now without their electric arc light system, and as a natural consequence very few telephone exchanges are in a position to assume that they are not, and cannot be liable to a danger due to a cross between the two classes of conductors. This source of dangerous currents has in fact completely overshadowed the older and more natural exposition of electrical fire-works, and it behooves us to look the danger in the face, to prepare for the catastrophe which may never come—and to prevent it, if possible. Not that lightning does not even now scatter destruction along its path; not that we must fear and guard against the lightning discharge less; but that we must look out for, and guard against, the adverse electric lighting current more. Of course every telephone exchange manager hopes and believes that everybody else's plant will suffer before the danger comes nigh him, but it is just as much a truism now as in the days of the wise, but uxorious Solomon, that "the prudent man seeth the evil and hideth himself, but the foolish pass on and are punished." The Gaul in his own habit of thinking points a moral by the aphorism that "It is always the unexpected that happens," while the more calculating Teuton shows his views by the cautious statement "Then you must look oud." We are not without examples of costly ruin in telephone property from the causes I am speaking about, and I think I am justified in believing that the instances made public are few in number, compared to those which have remained in obscurity, although perhaps more far reaching in importance and more extensive in intrinsic value. Boston, New Orleans, Toronto and other places have had central offices gutted from electric light currents. Omaha has, I understand, suffered dreadfully from lightning, and the isolated cases where single subscribers' outfits have been destroyed and annunciator drops damaged, have even within my own limited observation been of great frequency. What then are we doing, or going to do about it? Were these places warned of the destruction before them? Some of them were to my certain knowledge both by example and precept. I myself have lifted up the voice of warning to protect both ends of the telephone circuit; and in one or two instances have been laughed at and called an alarmist. In the case of Boston, several small conflagrations took place, bells were burnt out, and sections of cable were destroyed before the grand stroke came, but the warning was not taken and the Boston central office was burned. The result was not altogether without benefit, for the central office in that city has, I believe, not a single wire entering, which is now unprotected at the office end; showing that its managers have at least in some measure profited by experience. Again I ask, what are we doing, or what can we do, to prevent or diminish destruction from these devastating influences?

With respect to lightning, we cannot do much more than we are, and have been, doing for a long time. We should protect our central offices as far as possible, I think, by providing them with a high projecting and thick copper lightning rod, stretching far down into the earth, not fastened to the building by little rings of glass, in the style adopted by the peripatetic lightning-rod man, but stapled to the building itself, for it *is* possible that a discharge of lightning might find an opportunity, having struck the building, to escape by way of the rod; but it is not conceivable that a discharge of electricity traversing the rod could be lightly induced to forsake good honest copper for bricks or wood. If any lightning can be found with such dishonest and illegitimate propensities, we may rest assured that little glass insulating rings will exercise no restraining power on it. We should be liberal in the size of our ground wires, both in central and subscribers' stations. Too often the terminal ground at the end of a subscriber's line is nothing but a flimsy No. 18 S. W. G. copper wire, twisted three times round an unscraped gas-pipe. We should insist upon better lightning arresters at the central station for each line. The best, I think, is a kind which I do not often see—namely, a form in which advantage is taken of the habit of high-tension electricity to pass promptly from a point to a plate. Now, as my experience leads me to believe that damages are due to an equalizing discharge from the earth about as often as from the direct stroke, I hold that both points and plate surfaces should be provided for both sides of the lightning arrester, so that discharge in either direction may be facilitated. Let us now consider the electric currents. Perfect security will only be achieved from dynamo currents when the electric light and telephone companies shall combine for the best interests of both; when both learn to see that a disaster to one is in but a less degree a disaster to the other; when the lineman of one company shall cease to regard the presence of another company's wires at any point or place as a personal insult, and as a sufficient reason for them to be elsewhere; when electric light companies will refrain from using wire unless it be insulated with an insulating material instead of with a covering only; and when telephone linemen will have no serious objection to going a foot or two out of the preordained route, when they come near to an electric light or power wire. Failing, however, to attain perfect security, the next best thing is as perfect security as we can attain. To gain this we require, first, a thorough grade of construction; we need also some efficient automatically operating protector, not only at the central office end of every line, but also one for each wire where the conductors emerge from the cable, if an outgoing cable is used. These precautions are to defend the cables and the central station apparatus. What availeth it, however, if the central station and connecting wire are saved, if but one subscriber's station be destroyed? And if subscribers' stations are left unprotected, who dare say that even to-morrow the powerful electric lightning current by some accident may not (and the more likely if the central station end is fully protected) pass along the subscriber's line and destroy his instruments, or what assurance have we, should such a thing happen, that the telephone instruments will be the only articles burned?

One fire caused by an electric light current entering a subscriber's house or office, if it should be at all serious, would be a worse blow to any telephone company than a dozen affecting the central office or conductors only. This is no vain caution. I have thought deeply of what I say, and I repeat that where the electric light wires parallel and intersect the telephone wires in our streets, that telephone is barely half protected against the heating effects of electric currents that has a protector at the office or cable end of each wire only. This applies, of course, equally to private lines. Even while I am penning these lines, I am informed that a private line leading out of this office has had all four of its bells burned out, all of which might have been saved had each station been fitted with protectors. If a cable occupies an intermediate position, its wires, in my opinion, require protectors at both ends of the cable. The question now arises, what form of protector is to be used? Two broad and comprehensive classes are more or less known—viz., those in which a coarse wire electro-magnet included in the telephone circuit at the points to be protected is used to break the circuit or shunt the instruments upon the passage of an abnormally strong current through the wires, the magnet being non-operative when the ordinary telephone or magneto currents are passing; second, those in which an attenuating strip of metal foil or wire is made to form a part of the circuit outside of the portion to be protected, this having a sufficient conductivity for the ordinary currents, but being adapted to burn out, fuse, volatilize or deflagrate, when a dangerous current passes.

Both of these classes may again have diverse functions. They may, for example, be adapted to simply break the circuit, producing a space so wide that the current cannot overleap it, notwithstanding its great electromotive force; or they may be adapted to open the circuit, and then to put one or both of the severed ends to earth, for the escape of the electricity. Each have their weak and their strong points. Protectors depending for their action upon electro-magnets are reasonably sure in their action, and are prompt because the magnetizing effect of a current is swifter than its heating effect. On the other hand, electro-magnets in telephonic circuits interpose a much higher opposition to the passage of the telephonic current than might be expected from their resistance only, by reason of the counter currents generated in their coils by the changes in their magnetism; and electro-magnetic appliances irrespective of their simplicity are necessarily higher in first cost than are the fusible protectors. It is proper, however, to state here that magnets of such low resistance as is required for these appliances are not extremely troublesome in the first respect. It is rather remarkable that one of the first lightning arresters used in connection with telegraph lines in the United States consisted of a coarse wire magnet through which the main circuit led to the regular instruments, and which was provided with an armature and contact points; the armature was connected with a branch wire leading from the circuit wire and ordinarily open, and the fixed contact point was united to a ground wire. When a heavy discharge of lightning came along, the magnet was for a moment vitalized, and at racting its armature connected the line instantly but temporarily to earth, thus discharging the line. This was devised by Mr. J. D. Reid, who is still, I believe, connected with the Western Union Telegraph Company.

The most effective appliance of this class, in my opinion, is the simple arrangement invented by Dr. S. M. Plush, General Manager of the Philadelphia Bell Telephone Co., and comprising a small electro-magnet mounted on an insulating base; this is provided with an armature, as usual, and the armature has a lever ending in a catch which, when at rest, holds a spring lever in place. The circuit is led through the magnet coil, armature lever and spring lever, so that when the armature is attracted the spring lever is liberated and flies back, leaving an opening of some six or seven inches in the circuit, and preventing damage to the instruments inside of the safety appliance. I have heard nothing but good of this appliance. It is extensively used in Philadelphia, and I regard it as being a very efficient protector indeed, and its first failure has yet to be heard of. The worst thing that can be said of it is, that after one is opened it has to be manually attended to before the circuit can be used. Like all other electrical appliances, it requires to be well made to give good work.

Other electro-magnetic devices have been invented of various kinds and for various auxiliary purposes; for example, one is so arranged that it grounds the circuit through contact points as long as the dangerous current is passing, and restores the original state of things when the danger is over. This is done by winding the magnet with two wires—a coarse and fine one, as in the Brush lamp. Both wires are at first in the circuit, but the arrival of a dangerous current excites the magnet core first by an increased current in the fine wire, and then by the coarse wire coil, and attracts an armature that remains irresponsive to the telephonic currents. When this armature is fully attracted it shunts the fine wire coil and grounds the line and the instruments until the danger is over, when the armature spontaneously falls back, restoring the normal condition. The use of the fine wire is to excite the core and operate the armature, even though the current be not sufficiently high to operate through the coarse coil at first. Still another form uses the end of the iron core as the ground contact. Another combines this general form of protector, with an electric bell to indicate the occurrence of danger audibly. My own idea is, however, that appliances for the purpose cannot be too simply made, and that we, as a rule, multiply complication in direct ratio to the multiplication of functions.

Referring again to the fusible link protectors; it is no new idea to use fusible wires and strips as lightning arresters. But they were not readily adapted to telephony. These, too, have their own vices and virtues. They are, for example, too susceptible to even the smallest lightning storm; for after every storm a number have to be replaced (that is, if tin foil be used). The tin foil protectors are also somewhat difficult to mount, so as to make a good connection with the line wire, and it is not an easy matter to provide just the thickness and width of foil that will fuse or give way with currents which are of medium intensity, and these currents are the most dangerous, because with them the wires heat gradually and are liable to keep the insulation of the wires just at a smoldering heat for a long time before they finally break into a blaze. Yet, fusible links are cheap; they cannot generate counter electromotive forces, and if mounted by the manufacturer into a complete appliance prior to attachment, they are easy to attach. It must be remembered that fusible protectors need not necessarily be made of tinfoil. Lead foil or wire or fusible alloy strips can and have been used. Very fine wires, say, about No. 40 of iron, and German silver have been used; and it is matter of history that the New Orleans exchange, as early as the period when it was managed by W. H. Bofinger, employed platinum wire protectors not only at the central station, but also at the subscriber's end of the line. So many differing and adventitious circumstances enter into individual cases that it is impossible for me to say arbitrarily that tinfoil is better than fine wire, or *vice versa*. One dynamo, for example, may be a forty-lamp, another a twenty-lamp, and still another a ten-lamp machine, and a wire of high resistance which would instantly volatilize with the first machine might not even redden with the last. The main point which I desire to accentuate is, recapitulating the subject of my paper, "the necessity of protecting telephone exchanges, circuits and appliances from the destructive effects of intense electric currents and discharges;" the necessity of some form of protection, whether it be electro-magnectic or fusible, and the equal necessity of protecting both ends of the circuit with equal diligence and care. This much may be said in favor of the fine wire (and for the material I prefer German silver), that it is easier applied than any other form, all the essential features being two screws, a pair of copper burrs on each, and about five inches of fine wire twisted round each screw. I have no objection also to say that my own personal preference is for a well-made Plush electro-magnetic protector.

I think a few words on the question whether it be best to *open* a circuit crossed with an electric light wire, or whether it should be grounded by the action of the protector may not be amiss. While I believe the first thought of most persons would be to ground the circuit, I believe also that the sober second thought would be in favor of opening. For these reasons: the circuit, once opened, is innocuous; the current, so far as that line is concerned, has softly and suddenly vanished away, like the gentleman who hunted a snark and found it a boojum, and it is in fact *non est*. But if the protecting appliance act to ground the circuit or merely to shunt the instruments, not only is there likely to be a dangerous spark and flash at the contacts, but the current is still there—there to complete its murderous and incendiary work the first chance it gets; there to pass on to the next station and to repeat its wayward performances. There is, furthermore, another point we cannot overlook—placing a grounding appliance upon our circuits may, if it comes into action, endanger the life and health of the dynamo machine itself by short circuiting, and thus render still more untractable the already uncanny electric light man. During the last three or four years a great number of protecting appliances have been patented, and a great number of promoters and organizers have tried to organize stock companies based upon the merits of this protector or that protector, of course with the object of selling the stock and then looking for other worlds to protect. These companies are good things to fight shy of. There is not enough, even in a meritorious protector or in a meritorious individual signal instrument, to found a stock company on, and I have seen the rise, decline and fall of many such organizations. There is still another feature of this subject which needs attention. This is the line wire itself. The telephone line should not be supported near the electric light wire, it should rather be strung over a circuitous route. Where the telephone wire crosses or is crossed by electric light wires it is a good idea to encase it in a split tube of wood or like material, the two halves being fastened together by screws or wires. This simple precaution may prevent a serious loss.

I hope I have laid this subject forcibly before you. There is no telephone company so poor that it cannot at least afford the simple wire protector; none so rich that it can afford the loss of its own central station or the store or office of its patrons No telephone manager should, in my humble opinion, be satisfied with less than the best. It may be that all the exchanges of all the licensees of the American Bell Telephone Company are already fitted with protectors. I sent out no letters of inquiry, because I have before this year been upon committees, and I know the general futility of such inquiries; still I could wish that such a satisfactory state of affairs existed. I fear, however, it does not. If, then, this paper gives rise to serious thought upon the subject, I shall be repaid for the labor I have bestowed upon it, and for the pain which I sympathetically suffer in inflicting it upon you. I will conclude by stating that I looked through the published proceedings of this association before writing this paper and found that there was nothing exactly like it before; but I may also say, that it well repays any one to frequently re-peruse these proceedings, and that one who has only read his annual copy once and has then shelved it, will be surprised to find the immense amount of information and detailed experience which is embodied therein. Since finishing this paper, I have become more firmly impressed with the idea that the tinfoil protector is not as well adapted even for the subscriber's station as it is for the central stations. We have just passed through the summer season, and it is true, although 'tis also a pity, that not a lightning storm can occur or has occurred in Boston without disrupting a great number of these protectors. This effect is bad enough at the central station, but would be much more troublesome occurring at a number of, say fifty, subscribers' stations simultaneously, and for this reason I am disposed to believe that an electro-magnetic protector that opens the circuit will generally be more satisfactory than a foil protector.

Discussion of the paper was postponed until Wednesday morning.

It having been agreed during the afternoon, on motion of Mr. Carson, to send contributions to Charleston for the sufferers by the earthquake, a committee, of Messrs. Carson and Eastabrook, was appointed to receive moneys for that purpose. Before the convention closed the committee were able to send $285 to Charleston in the name of the members present.

Adjourned till 10 a. m. Wednesday.

The proceedings on Wednesday opened with a short dis-

cussion of Mr. Lockwood's paper. Mr. E. J. Hall, Jr., explained the system of fine wires in use for the "long-distance" lines between New York and Philadelphia. Mr. Keller stated that the electrician of his company, Mr. Farnham, had improved their tinfoil strips by making them lighter at the exact centre, and they now had no trouble with them. Simply the ends of the cables and the cupolas were equipped, not the subscribers' ends. Mr. Metzger stated that in Pittsburgh they used gold foil paper very successfully. In a recent storm, 68 of the gold foils were burnt out in half an hour—showing their efficiency in protection.

Mr. Storke then read a paper on

THE TELEPHONIC LEGISLATION OF 1886.

The paper touched at the outset upon the Indiana troubles and the underground question. In one part Mr. Storke remarked: "It is proper here to say, that, as far as I know, telephone companies have had little to complain of in the way of enactments relating to their duties as common carriers or aimed to reach their property for assessment and taxation. These in the main have been fair, and under them our interests are probably as well protected as those of other corporations. There is a feeling among telephone people that they are the object of special attack, and that there is a particularly strong prejudice against their business. This is in a measure true, but I imagine it is felt more deeply because it is our ox that is gored. Telegraphs, railroads, banks and financial institutions of all kinds are just now the object of similar attack, and we are not perhaps greater sufferers than others." * * * "Notwithstanding existing prejudices and the use made of isolated instances of profit, the situation remains practically where it was a year ago. The Indiana experiment is the only one yet made, and the results in that State would not seem to encourage similar interference with the laws of trade elsewhere." Mr. Storke then summarized the legislation of the year as follows: "The Legislatures of Maine, New Hampshire and Vermont did not convene last winter. In Massachusetts, strenuous efforts to regulate rentals were made; a general law was proposed placing all telephone and telegraph companies under State supervision, also a special law placing them under the supervision of the Railroad Commission. There was also some agitation before the committee regarding compulsory legislation for placing all wires under ground. These measures were all reported adversely by the committees, but were called up later in the legislative halls. The rate bills were brought up in the House of Representatives and defeated by a large majority. The bills for State and railroad commission supervision originated in the Senate and there died. In Rhode Island no telephone legislation was attempted. In Connecticut, the only bill affecting telephone interests was one to reduce rates, which died an easy and natural death. It was regarded as purely an individual attack, without backing from public sentiment in that State. In New York, rate and commission bills were introduced both in the House and Senate, but failed to become laws. In New Jersey, no laws affecting telephone interests have been passed. A three-dollar rate bill was fully discussed before the committee and defeated. A bill affecting long-distance companies was introduced, but was afterward withdrawn. Its object was to interfere with the right of the long-distance companies in leasing offices in connection with any local company. A substitute for a bill compelling the companies to bury their wires, and permitting them to acquire underground rights, was introduced but not passed. The Pennsylvania Legislature did not meet last winter. In Maryland, no laws were enacted. In the Southern Bell territory, no bills have been introduced affecting telephone interests. The Legislatures of Arkansas, Minnesota, Texas and Dakota did not meet last winter. In Ohio, the Indiana bill was introduced, but was defeated."

The subsequent discussion did not elicit any facts of great novelty or importance. It appeared from the statements made with regard to charging so much per connection, in Indiana, under the new régime, that the returns were not particularly satisfactory up to the present time. The general opinion of the members was that, wherever obtainable, a guaranteed minimum should be insisted upon.

At the close of the discussion an invitation was read from Dr. Wellington Adams to members, to see the operation of the toll system with which his name is connected.

Mr. C. N. Fay then read the following paper on

UNDERGROUND WORK.

Last year I had the honor to lay before you some observations on the use of cables in cities, from which I drew two general conclusions: First, that no cable, overhead or underground, had failed to work over a reasonable distance and for a reasonable time when properly made and connected up; second, that managers of city exchanges should labor to bring before the public the advantage of mixed systems of overhead and underground cables, and connecting with aërial lines at distributing points as being the most flexible and convenient and the least expensive system in the long run for both the public and the telephone companies. Another year's experience has somewhat modified my confidence in the working of cables, but has, if anything confirmed my belief in the desirability of a mixed system. I will consider this part of the question first, and come later to the working of cables.

A flood of light has been thrown upon the problem of underground wires by the labors of the Underground Commissions in the Cities of New York and Brooklyn. The Commission in the City of New York investigated a great many plans, heard from a great many inventors, took a great deal of testimony, and spent considerable time without accomplishing much of anything until its Presidency was assumed by the Honorable Roswell P. Flower. Mr. Flower is unquestionably an honest man of great ability and energy, determined to carry out the duties imposed upon the Commission without unnecessary delay, even if this involves "taking the bull by the horns" now and then, and he has done so. The net result up to date is the beginning of a trench on Sixth Avenue, in which it is proposed to lay a multitubular conduit made of some kind of asphalt-concrete.

The law which created the Commission charged it to enforce the underground law of 1884; it allowed the various electric companies sixty days in which to prepare plans for putting down their wires themselves, to be approved by the Commission; if they failed to do so within sixty days, it charged the Commission with the preparation of a general plan, and authorized them to compel all companies to use this general plan. It further gave the Commission, in order to avoid impairing the efficiency of electric service, discretionary authority to allow the maintenance of aërial lines and cables under particular regulations "wherever needed for the convenient use of the public, or where the underground conductors can be made thereby more useful."

But the law, while making it the duty of the Commission to enforce the placing of these wires under ground by means of a general plan or system, provided no funds for the construction of such a plan or system. The Commission, therefore, took the first bull by the horns in assuming that the act conferred by implication the authority to create, or cause to be created, a conduit company to build the conduits for hire, and to force the various electric companies to use the conduit company's facilities upon a rental to be fixed or approved by the Commission. So such a company was organized, and is proceeding to build the conduit. Of course, a magnificent opportunity was afforded for a job, and, as is well known, New York politicians are not behindhand in seizing such opportunities. Messrs. Flynn and O'Brien were active in connection with the work of the Commission, and were undoubtedly interested in the conduit company formed. Their recent exposure and political downfall came just when the company was in the full tide of success, had been accepted by the Commission, had made its contracts, and was about to call on its members for money. (I would say, in passing, that public charges of jobbery and corruption were made against this company and against the choice of material made for the conduit, but Mr. Flower again took the bull by the horns and awarded the contract to the company, and for the material which, all things taken together, he deemed would best carry out the act without unnecessary delay.)

The scandal attending the Flynn-O'Brien exposure has given the Company a severe blow, from which it is not certain whether it will recover. Both of these worthies are said to have withdrawn from the Company; its president resigned, and no responsible man can be found to take his place; and the subscribers of its capital stock, fearing a repetition of such a disaster as befell the Broadway Surface Road in the forefeiture of its charter, are said to be very slow in coming forward with their money. However that may be, all telephone men will agree with me, I think, in saying that *if* all companies must be forced to use a general conduit, some sort of a drawing-in system is inevitable, and that of all materials for such a conduit an asphalt-concrete is probably the best. Further, that if *reasonable* rentals are charged, although it would be better that the conduit should be and remain the property of the city, yet where public funds are lacking, there is no good reason why a private corporation should not supply them. For my part, if I were doing electric business in New York, I should have no earthly objection to any man's investing his money in a conduit system, the completer the better. I should not care to put any money into it myself, but would welcome the facilities so offered by anybody else.

But I think that every telephone man will agree with me that all companies should not be forced into one general conduit. When I said that a flood of light had been let in on this question by the proceedings in New York, I did not refer so much to the education of telephone or electric light men as to that of the newspapers and the public generally. The evident jobbery of the thing attracted universal attention among all the papers, notably the New York *Sun* and *World* were round in their denunciation of those who were attempting, as they expressed it, to levy perpetual blackmail upon the electric companies. It became evident at once to the newspapers what an amount of tearing up and digging was to be done in the public streets, how many subterranean obstructions in the way of gas and water pipes, steam pipes, sewers, area vaults, etc., lay in the way of the proposed conduits; that a general system of gridironing the city would be of far more serious detriment than the present eye-sore of poles and wires. Not being upon the ground, I cannot say to how great an extent the Commissioners were enlightened. I had the honor of being consulted by Mr. Flower twice on the subject, and once or twice by the engineer and chemist of the Commission. I suggested to Mr. Flower to obtain from each electric company a plat of the underground system that would suit its convenience, showing where its masses of wires were located, and indicating the routes which would be shortest and cheapest for itself; to take all of these plats and superpose them in different colored inks on a map of the City of New York, and note the coincidences. I felt quite confident that if this were done coincidences to any considerable extent would be very rare. The main routes of the telegraph companies and the trunk lines of the telephone companies might coincide in a city like New York along two or three thoroughfares north or south, but the great bunches of telephone subscribers' wires, the electric light and district telegraph circuits would not coincide with the above nor with each other, but would form a complication to provide for which, adequately and economically, would be an exceedingly difficult problem. I instanced the experience of the underground company in Chicago, which completed over a year ago a system of some twelve miles of seven to twenty hole conduits, covering pretty thoroughly the business portion of the city. In a very few of the streets this conduit is half filled and indicates over-crowding in the future. In all of the other streets it is nearly empty. There is no law under which the electric companies in Chicago can be compelled to use this conduit, and I doubt exceedingly whether under the act creating the commissions, the New York companies can be forced to use the Conduit Company's facilities there.

However that may be, in Chicago its geographical position is such that it cannot be used to advantage, and the companies have gone on of themselves putting down their own wires each on its own system. Two or three leading streets have been torn up two or three times, but as a whole the companies working each for itself have selected the shortest route and the smallest possible number of streets; and in putting practically three-fourths of their working wires underground in the business section of the city have torn up less than two miles of streets, the gridiron arrangement of the Conduit Company having, as I said before, torn up over twelve miles, the greater portion of which is useless.

In New York the experiment has not gone far enough to satisfy the public and the Commission of these facts, but a year or two of experience in that city will be sufficient, I think, to show the whole community that the best way of dealing with the underground problem is to let the companies interested put down their own wires each for itself, using the roofs, alleys and pole lines where, in the language of the New York act, they are needed for the convenient use of the public. In the city of Brooklyn, the intelligence and honesty of whose municipal management seems to be reflected in that of its Underground Commission, this is precisely what has been done. The work of the New York Commission has stirred up the underground question all over the country. In some of the cities the Common Councils have very wisely deferred action to await results in New York, a disposition which ought to be encouraged by the exchange men everywhere.

Passing now to the practical working of cables. I addressed the following inquiries to the managers of the principal exchanges using them:

"Some time ago Mr. Jaques, of the American Bell Company, and Mr. Patterson, of the Western Electric, obtained experimentally an arbitrary formula, which they thought indicated the limits of transmission of speech by cable. It was as follows: When the static capacity of any conductor in the cable multiplied by its resistance multiplied by the square of the length of the conductor in miles exceeds 12,000, telephonic transmission becomes impossible. In practice a margin of one-half should be allowed for loss in outside connections and instruments, so the product of foregoing factors should not be over 6,000.

"I would very much like to know how this formula is borne out by your experience in underground work, and also the general results of your use of cables, and to that end would request your kind answer to the following questions: Lengths and kinds of cables used, overhead and underground? Average resistance per conductor per mile in each cable? Average static capacity per conductor per mile in each cable? Average insulation per conductor per mile in each cable? Trouble with cross-talk in each cable, overhead and underground? Trouble from retardation in each cable, overhead and underground? Trouble with terminals? Other weak points? Cost of cheapest cable? I would call particular attention to the comparison of overhead and underground working results." I will here read their replies:

AUGUST 19th, 1886.

"*C. N. Fay, Esq., Vice-President, etc.:*

"MY DEAR SIR—Replying to yours of 7th. I have had no means of determining whether the Jaques formula is correct, but as it does not take into account self induction, I do not think it a very safe formula.

"The greatest length we have had underground is 2,400 feet, and in this length no serious difficulties occur. There is a little cross-talk, but no perceptible retardation.

"We use lead-covered cables furnished by Brooks, of Philadelphia, and the Western Electric Company. Conductors, principally No. 20 standard gauge, 44 to 45 ohms per mile. Have made no tests for capacity. The average insulation is 50 megohms per mile; when they go below that we look for defects. Our greatest trouble has been with the terminals; the last ones put on by the Western Electric Company are very satisfactory. One of our cables in the conduit furnished by Brooks is corroding by the action of water gas, and ultimately the whole lead pipe will be turned into carbonate—possibly another year will complete the work. We have paid forty-two cents for 50, and sixty-seven cents for 100-wire cables. Prices are much lower now, about thirty-three and fifty-three. We do not notice any difference in cables overhead and underground in the lengths we now have.

"The poor condition of my health since last February has prevented my doing as much work as I had intended.

"With the underground work we are now completing we shall have cables over two miles in length, and from them I expect to be able to get some information which I hope will be of value. Yours truly,

(Signed) "W. D. SARGENT, General Manager."

"*C. N. Fay, Esq., Chicago, Ill.* AUGUST 10, 1886.

"DEAR SIR: Replying to your favor of the 9th, I beg to say our experience with cables is very limited. I expect our trouble to begin very soon. We are preparing to put up about three miles of aërial cables. The longest will be about 1,500 feet. We will use Patterson's No. 20 B. & S. gauge 100 conductors for short lengths, and Day's Kerite, with anti-induction insulation, for long cables. We have but one cable now in use over 1,000 feet. The cable referred to is, or was, until last week, a Patterson aërial, 50 conductors, No. 22 B. & S. gauge, 1,900 feet long. This cable has been in use on the Newport-Cincinnati bridge for nearly three years, carrying trunk lines between Covington and Cincinnati exchanges. We have experienced so much trouble from cross-talk that we have not been able to get any new subscribers and have lost 21 of the old subscribers since this cable was put up. I decided this spring to put up a new cable and take down the Patterson, if a manufacturer could be found who would make and warrant a cable that would work satisfactorily and free from cross-talk. The Standard of Pittsburgh undertook the job. Their cable is up and working, but they are not yet through making experiments, and I must decline to report results until they are.

"We have no underground cables in use.

"Yours very truly,

(Signed) "G. M. STONE, General Manager."

"AUGUST 24, 1886.

"*C. N. Fay, Esq., Second Vice-Prest. and Gen'l Mgr.*

"DEAR SIR: Referring to your letter of the 9th inst., I have to say that my facilities for investigation will hardly permit of a detailed reply to your various questions. I will, however, with pleasure give you such general information as I possess upon the subject.

"We have working in Boston twenty-five aërial and nine underground cables. The aërial are in length from three hundred to fourteen thousand feet, the latter figures being obtained by joining more than one continuous length. The size of the conductors varies from 26 to 18 B. & S. gauge, the small size being in old cables and in lengths of not more than two thousand feet. The greater number of our cables have conductors of Nos. 20 and 22 B. & S. gauge; a few have No. 18. Our longest lengths are Patterson, as is also by far the greater portion of our cable system. Besides that make we have a few Phillips cables, one of which is seventeen hundred and twenty-five feet in length, of one hundred conductors, No. 22 gauge.

"Our longest underground continuous lengths are 1,500 feet, all Patterson cable, and the greater number of conductors No. 18 B. & S. gauge.

"The measurements for insulation and capacity which you request could not have been made in the time allowed, as such measurements, to be of any value, must be large in number and made with the greatest care. To insure accuracy terminal heads would also have to be removed,

as there would be an uncertain amount of escape at those points. Even with ample time, I fear that we have no instruments suitable for such measurements. Such investigations, however, will be of the greatest interest and value if the necessary care and time can be taken for their prosecution.

"In regard to any comparison between underground and aërial cables, it is impossible to make such with any degree of certainty without the same conditions—style, size and length, etc.—of cables, which similarity of conditions does not exist in our systems. In practice, we detect no difference in the working of aërial and underground Patterson cables of approximately the same length.

"The superintendent of our operating room in Boston, and also our chief operator, concur in the above statement.

"In the case of long lines connected with other exchanges we notice considerable difference in results when comparing lines consisting of open wire for the entire length with those which for any part of the distance enter a cable, the loss of distinctness caused by retardation being very noticeable in lines connected with cable.

"I hope that the investigations now in progress will be extended to Patterson cables, made with more than the usual distance between conductors, and that this valuable data may be obtained.

"I am sorry that my facilities do not enable me to give a more extended answer to your letter.

"I am very truly yours,
(Signed) "J. N. KELLER, General Manager."

"NEW YORK, Aug. 31, 1886.

"*C. N. Fay, Esq., General Manager, Chicago, Ill.:*

"DEAR SIR: Your letter of Aug. 7 and telegram of Aug. 30 received. I regret that a full reply to your letter was delayed on account of sickness, and am yet unable to furnish *all* the information you desire, but I send what I have, hoping that it may be of service to you.

"In reply to your first question, Lengths and kinds of cable used, overhead and underground.

"Answer. Underground: greatest length in one piece, one mile Patterson 50-conductor cable, laid in Brooklyn.

"In connection with our Thirty-ninth street exchange, 1,939 feet 100-conductor cable, Patterson cable.

"In connection with our Twenty-first street exchange, 1,694 feet Edison cable, 300 conductor in one conduit and 200 conductor in another.

"In connection with our Spring street exchange, 2,248 feet Brooks cable, 400 conductor in one conduit.

"Overhead (aërial) cables: "Greatest length, 1 mile: A. G. Day Kerite cable, 38 conductors, and 2,717 feet Patterson 50-conductor cables.

"2d. Question.—Average resistance per conductor per mile in each cable.

"Answer.—Underground Patterson cable in Brooklyn, No. 16 English gauge, 13 ohms per mile.

"Note.—I have not got the figures at hand for any of our other cables.

"3d. Question.—Average static capacity per conductor per mile in each cable.

"Answer.—Patterson underground cable, Brooklyn, .20 microfarad per mile.

"Thirty-ninth street underground cable (Patterson), .22 microfarad per mile.

"Twenty-first street underground cable (Edison), .25 microfarad per mile.

"Spring street underground cable (Brooks), .21 microfarad per mile.

"Note.—This is all I can furnish you with at the present time.

"4th. Question. Average insulation per conductor per mile in each cable.

"Answer.—Patterson underground cable in Brooklyn, 27 megohms per mile.

"Patterson underground cable in Thirty-ninth street exchange, 300 megohms per mile.

"Edison underground cable in Twenty-first street exchange, 1 megohm per mile.

"Brooks underground cable in Spring street exchange, 30 megohms per mile.

"Note.—We are still carrying on experiments in connection with above.

"5th. Question.—Trouble with cross-talk in each cable overhead and underground.

"Answer.—We have slight cross-talk only with Patterson underground system at Thirty-ninth street, and none with same system in Brooklyn. With the Edison and Brooks' system there is slight cross-talk only, and the same may be said of all our overhead (aërial) cables.

"6th. Question.—Trouble from retardation in each cable, overhead and underground.

"Answer.—We are not affected by retardation.

"7th. Question.—Trouble with terminals. Other weak points.

"Answer.—We have no trouble with terminals, with the exception of Patterson cables. We find it difficult to keep the moisture out.

"8th. Question.—Cost of cheapest cable.

"Answer.—Aërial, Patterson; underground, Brooks.

"Average cost of 100-conductor Patterson cable, $1.15 per foot.

"Average cost of 50-conductor Patterson cable, 80 cents per foot.

"With regard to the comparison between (aërial) overhead and underground cables, I would say that taking length into consideration, we receive better results from underground than we do from (aërial) overhead cables.

"Respectfully,
(Signed) "W. H. ECKERT, General Supt.
"F."

"*C. N. Fay, Esq.:*

"SIR: Below please find memorandum of longest cables of each kind in use in Chicago:

UNDERGROUND.

Cables.	Location.	Length in ft.	Res., ohms per mile.	Capacity, M. F. per mile.	Ins. Res., megohms per mile.	Gauge cond'r.
Patterson	4 off. (D)	4,148	40	.23	1,000	18
Standard	3 "	4,110	35	.23	400	18
Kerite	2 " (Z)	1,600	30	.54	400	18+
Bitite	2 " (H)	1,100	...	.35	0.5	18

AERIAL.

Patterson	8 off.	2,754	80	.17	200.	22
Standard	8 "	5,403	100	..	40.	22
Brooks, Jr.	Tunnel.	900	200	..	0.2	32
Brooks Oil	"	900	200	..	0.5	26

"Our inspectors report induction and retardation in those cables to bear at a rough guess the following numerical proportion.

UNDERGROUND.

	Induction.	Retardation.
Patterson	45	25
Standard	30	25
Kerite	20	10
Bitite	20	15

AERIAL.

	Induction.	Retardation.
Patterson	35	25
Standard	30	30
Brooks, Jr.	None	50
Brooks, oil	30	40

"The Kerite and Brooks, Jr., cables are provided with induction shields. Respectfully submitted,
(Signed) "B. E. SUNNY, Supt."

The statistics given by these replies are, as you see, very meagre. In fact the desire for knowledge has only arisen recently with the necessity for it. Another year will probably add materially to our stock of information. At present it is insufficient to answer my query about the Jaques formula. I have derived some impressions, however, not sufficiently definite to be called conclusions, from our Chicago experience, which I will state, and supplement them from the remarks of the other managers.

In the Central District of the city of Chicago we have but one underground line of about 1,800 feet in length. It consists of Kerite and Patterson cables drawn into Dorsett conduit, and carries at present only subscribers' wires; but in the North, West, and South divisions of the city, where we have exchanges of about six hundred subscribers each, and which are not built up with tall buildings of uniform height as is the business district, last year we substituted for our pole lines underground cables reaching from a thousand feet to a mile away from the exchange. In the business district before mentioned most of our wires are in cables passing over the roofs of buildings. By connecting therefore from the North District through the business district to the West side we get a continuous length of nearly three miles in cables, of which about a mile was the Waring cable underground, another mile Patterson cable overhead, and another mile Patterson cable underground. Testing these conductors by themselves last January, without connection with aërial wires at either end, we found but little cross-talk in the new underground work, but a great deal in the old aërial cables. This fall testing again, we find considerable cross-talk in all of those cables; we find that the insulation runs down rapidly and is very difficult to keep up; that most of this failure is in the terminals; that as the insulation runs down the cross-talk increases; that in comparison with the old overhead systems the cross-talk is probably two or three times as great. As regards insulation the cable portion of our wires is much more highly insulated than the old aërial wires, especially as we used to run them upon porcelain knobs. We find that the paraffine cables absorb moisture at the terminals, and that it is very difficult to keep up the insulation on that account. It is true, however, that insulation of three or four hundred megohms, such as we have had at the beginning on most of our cables, might be called "too fancy" for practical use. We are attempting to keep up an insulation on our cable work that we do not follow out throughout the switch-board, office wires, etc.

The general result of our cable work is unsatisfactory by reason of cross-talk and indistinctness of transmission. We have spent a great deal of time and money measuring up lines, cutting out bad points and rebuilding and putting everything in shape. One of our best inspectors thinks that the indistinctness of transmission is due very largely to poor contacts in the switch-board, caused either by iron plugs which rust or by phosphor-bronze on other contact points, which tarnish. This theory has been broached but lately, and we are now at work upon it; but I fear that the increasing use of cables is destroying the satisfactory character of telephone transmission. We expect this year to put down two miles and a half of Brooks oil cable throughout the central district, connecting our whole system together. When this is completed, a few months' use will show whether my fears are well-founded; but I have serious doubts whether we can, after this year, continue further our underground extensions.

All these observations are fragmentary and crude. Among the odd bits of information we get are these: If a cable conductor forms part of a circuit of heavy resistance it causes more cross-talks than when forming part of a circuit of light resistance. This agrees with the Boston experience wherein transmission is poorer when cable lines are used in connection with long country wires.

From one of our underground cables, which we have the opportunity of testing, testing wires are run into the Western Electric manufactory. These test wires are not grounded. We find that they become charged every now and then with electricity, always of the same polarity, and will discharge like a condenser on being connected with the earth. What the reason of this charge is we have no way of finding out, as we have no battery wires in the same cable, and know of no reason why an induced charge of the same polarity should always be derived from alternating currents like these of a magneto. Mr. Patterson says that since the earthquake he has not been able to get a flicker out of this cable. He is unable to say whether the earthquake has anything to do with it or not.

An interesting fact is, that the Brooklyn cable, a mile long, fifty wires, No. 16 gauge, shows no cross-talk. The insulation of this cable is but twenty-seven megohms, but its resistance is also very low, thirteen ohms to the mile. In Pittsburgh, cables two miles and six-tenths long have been put down as follows: One fifty-wire Patterson cable No. 18 gauge; one fifty-five wire cable, same gauge; one seven-wire Star cable, made by the Waring Company, No. 16 gauge. These cables are all of high insulation, 450 to 500 megohms. The static capacity of the fifty-wire cables is from .23 to .28 of a microfarad; that of the Star cable is .38; but, although the Star cable is of much lower resistance, it cannot be used with satisfaction, the Pittsburgh exchange depending upon the other two cables.

The very curious fact is notable that the Brooks, Jr., cable, with only one-fifth megohm of insulation resistance seems entirely free from cross-talk. This is probably due to the spiral induction shield in each wire, which carries to earth all escape.

Mr. Durant promised to lay before the Convention papers relating to the electrophore system for aërial wires, devised by Col. Flad, the well-known civil engineer of St. Louis.

Mr. W. D. Sargent then read the following paper:

UNDERGROUND WORK IN BROOKLYN.

The very rapid growth and accumulation of wires near our principal office in Brooklyn compelled the consideration of the underground question, regardless of the newspaper hue and cry and compulsory legislation. Unfortunately for the credit of our good intentions, no work was done until after the passage of the present Underground Act, in May, 1884.

It may be noted, in passing, that the sentiment against poles and overhead wires seems to have been manufactured by newspapers and underground companies with "an axe to grind," evidence of which is our present extensive system of poles and wires erected without protest from property owners and citizens.

In the summer of 1884, it was decided to attempt to place some wires under the streets. Believing that such a complex system as ours could never be fully accommodated by wires laid permanently in the ground, we decided to lay a conduit comprising a series of ducts, permitting the introduction and withdrawal of wires and cables, thus providing space for future growth, for the withdrawal of defective cables and the substitution of others, as experience determines are the most suitable.

Up to this time no cables or wires can be had whose durability has been sufficiently tested to warrant the faith to lay them permanently underground without an expectation of being able to reach them without tearing up the entire street. While the liability to damage when laid permanently underground may be very remote, facilities for handling cables without opening the street are worth providing for on economical grounds. In many of the systems already laid, it is customary to box the cables in wood and fill in with asphaltum or cement. The same box can just as well be left empty and the cables drawn in and out without much greater expense, provided the wood can be made durable.

In looking up the durability of wood laid underground, in which we were very much aided by the Commissioners of Electrical Subways, we found the most competent authorities agreed that the process of creosoting, when properly done, would preserve it indefinitely. Conduits of different materials—iron, cement, asphaltum, etc.—were examined, but creosoted wood appeared to be the cheapest and as durable as any. These considerations led to its final adoption for our conduit.

The form decided upon was a square box, sides, top and bottom 1½-inch plank, subdivided into ducts varying in number from ten to four, according to requirements, the division being made with 1-inch boards.

As the manholes in the first work were not very frequent, we anticipated that friction and the consequent strain of drawing in long and heavy cables might be sufficient to injure them. With the intention of obviating this difficulty, the ducts were made three inches high by two wide, and rollers were placed permanently in the bottom of each duct for the purpose of lessening friction. This we found to answer very satisfactorily.

In the season of 1885, the Underground Commisioners assumed direction, and at their suggestion, the rollers were made into small carriages, consisting of two rollers below, one above, the cable resting upon the upper roller, the intention being to withdraw the carriages after the cable was pulled in and using them for successive cables. In the more extensive work which we have done in 1886, manholes becoming more frequent, we find that lengths of 1,000 feet or less may be readily drawn in without injury to the cable and without rollers or any anti-friction device. (The blue print drawing which is here for the inspection of members interested shows all the details without further description).

The general plan of distribution contemplated for the 13 miles of conduit which will be completed this year, is to bring the cables out to poles or on the house-tops in bunches of 25, 50 and 100, and distributing as now through the air. This method of distribution has been permitted by our Underground Commissioners pending the development of something better. We are not prepared to offer any plan for introducing individual wires into the buildings.

Preliminary to opening the streets, a map was made showing the location of water, gas and sewer pipes from information obtained from city departments and gas companies. This information proved to be as valuable as that of the pilot who knew every rock in the channel and when the ship struck, said, "There is one of them now," and it was in this way that we came to know every pipe in the street, that is, as we struck them.

We think it is safe to say the obstructions in the streets of Brooklyn are less than in many other cities of even smaller size. The character of the ground is sandy and usually easy digging, but frequently obstructed by large boulders which require blasting to remove them. There is no ledge of rock in Brooklyn. The proper way in laying out a line for an underground conduit is to dig test holes over the route desired, thus locating all obstructions and digging the trench accordingly. The depth of trench with us is usually 30 inches; but owing to service pipes for gas and water and occasional large mains, we have gone in some cases to a depth of seven feet.

As to the durability of our work, time alone will tell. The first half mile of our creosoted conduit will be down two years in November, and inspection just made before the writing of this paper shows no sign of decay in the timber, and the iron screws and nails are not corroded.

The objection usually made to this conduit is that it is not water-tight. This is true, nor did we attempt to make it so. The only damage that can result from water flowing through the duct is the accumulation of mud or silt sufficient to clog them up. In the work already done, after two years' service, a recent examination at several points showed no deposit of any kind, and we are able to move the cables freely. In order to prevent the possibility of this trouble in the more extensive work now in progress, we have adopted the plan of pouring hot pitch or asphaltum over all the joints, sealing them all effectually.

Regarding the location of manholes, these have heretofore been placed only at points of distribution and where obstructions rendered them necessary. The growth of the

underground system will doubtless require manholes at the junction of all streets.

The creosoted wood (North Carolina pine) is treated and furnished by an establishment in our own city. the price under our present contract being $41 per 1,000 feet, board measure, including mill work. The conduit is made up complete by our own workmen into sections of 10 feet, which are then carted to the trench, dropped in, joined up and covers screwed on.

Special care is taken where sections join to make the ducts continuous and in line. In addition to pitching the joints, the junction of sections is covered with felt and heavily pitched.

Work done by contract has its disadvantages, principally on account of inability to control the work as thoroughly as is desirable. For this reason, we decided to do the work ourselves this year, and it is probable the cost will be less. The advantage, however, is in the absolute control and thoroughness of the work. The ordinary Italian laborers are employed under suitable foremen.

We have made a contract with D. H. Dorsett for five miles of his asphaltum or concrete conduit, which is now well under way, but regarding which no figures can be given at present.

In cables we have used principally lead-covered pipe, furnished by the Western Electric, Brooks, and Faraday. These are made up in fifties and hundreds, with wires twisted in pairs. The twisting in pairs is done to provide for perfect metallic circuits when they become necessary. During the time we are using grounded circuits the interference between the wires of a pair is greater than if not twisted, if they happen to be used simultaneously. The possibility of this is very remote, and I do not think worth providing for.

One section of 4,500 feet just made by Brooks is interspersed with braided tinsel for the prevention of interference. No comparative tests have yet been made to determine its value. The balance of the cables are without any special device.

The first cables drawn in in 1881 began to show trouble in about eight months, and the manufacturers were notified, their investigation finding the trouble in the terminals, except in one Brooks cable, which was found badly corroded. One section of 500 feet was withdrawn in which was found a crack in the pipe at a wipe joint that had admitted moisture. New terminals were put on. The whole difficulty with the terminals is to get them moisture-tight. Within the last few months air and moisture tight terminals have been furnished, which we believe will prevent future trouble.

The durability of lead pipe is a very important question. The corrosion of the Brooks lead pipe has now reached one-eighth of an inch in depth, and the indications are that the whole pipe will be consumed. Opinions differ as to the cause of this corrosion. The product is undoubtedly carbonate of lead, and Professor Plympton says that it is caused by the action of water-gas, which collects in the ducts. Other authorities believe it is due to the vapor of acids in the creosoted woods. The pipe was made by Tatham Bros., of Philadelphia, and is said to be pure lead.

The Western electric cable has a small percentage of tin which was put in to stiffen the pipe; but it seems to serve another useful purpose, inasmuch as their cables, laid alongside the Brooks, show no sign of corrosion. It is fortunate that a remedy is so immediately indicated for what promises to be a serious evil.

Our greatest length of cable underground up to the present time has been 2,400 feet: interference is very slight and retardation not perceptible. The trunk wires between New York and Brooklyn work through two miles of cable without serious difficulty, and we don't anticipate our troubles will begin until we get beyond that point. The longest cables laid this year are 4,500 feet, and tests show that we shall have no difficulty in working them. The insulation varies from 50 megohms to 500 per mile. Static capacity not measured.

We expect to be able to maintain our pole wires for a reasonable time to insure durability of cable and to retain them entirely where the wires are less than 50. New poles will necessarily have to be put up to aid in distributing from the underground, and we are now putting up some for that purpose.

One of our Underground Commissioners is now in Europe, and in a letter from him dated Milan, he writes as follows: "I have heard of no underground telephone wires since I left London. I am a little in doubt about a few in Berlin, but the rule is, 'Mount them on the housetops.' The government can compel submission of the citizen, but awards him some compensation. Perhaps the most striking incident of the journey was the finding of a new line of telegraph poles in the streets of Antwerp. I have ordered a photograph of them. Preece says he never knew a case of failure of well-creosoted timber through decay."

This was written after the writer had been at Liverpool, London, Brussels, Antwerp, Cologne, Wiesbaden, Heidelberg, Frankfort, Berlin, Munich, Lucerne and Milan. This seems to indicate that the problem of underground wires for a telephone system is quite as difficult a question there as it is here.

The main point brought up in the brief discussion that followed was that the results obtained in various parts of the country on underground work are still contradictory, hardly allowing the formation of any very decided opinion. Another point was the desirability of using larger wires, with the object of increasing the conductivity. Mr. Lockwood emphasized this, and was supported by Mr. Hotchkiss, who insisted also on the necessity of increasing the body of the insulating material around the enlarged conductor.

Secretary Barney read a letter from M. Berthon covering statistical documents, etc., relative to telephonic work in France.

A brief communication was read from Dr. S. M. G. Plush on the working of the Law system in Philadelphia, with respect to which the Doctor made some favorable statements.

There being a few spare minutes before the mid-day adjournment, Mr. Lockwood read a humorous little article from *Punch*, called "Through the Telephone," giving a supposed telephonic conversation in London.

Adjourned till 10 A. M. Thursday, in order to accept the invitation of the local company to proceed down the Mississippi to Crystal City.

The meeting on Thursday opened with the reading of a paper by Mr. A. S. Hibbard on

LONG-DISTANCE TELEPHONY.

Mr. Hibbard, in this paper, written with his accustomed skill and ability, said that the problem of long-distance telephony was no nearer solution than it was a year ago, and he doubted whether the gradual occupation of territory by local companies would be found the means of solving it. "Among the improvements asked for are enough wires to accommodate everybody at the most busy time, no induction, no noisy wires, no weak effects and (*always*) cheaper rates. Any one of these items furnishes at least food for reflection. In the present system of single wire lines, a second wire to any given point necessitates a new line complete on a separate route. In most cases, the limited number of available highway routes would prevent the extension of more than three or four wires, and, at the 'busy time' mentioned, these might prove insufficient. The "noisy wire" and induction troubles have certainly not been surmounted, and we still must put up with weak and unsatisfactory effects. In rates, we find it impossible to compete with piratical telegraph companies. It seems, therefore, that at every issue we fail to meet the above-noted public demands, and yet the public use of toll lines increases. This is certainly conclusive evidence of the great service of such lines to the public and the great future of successful long-distance telephony. The various companies are apparently striving hard with the difficulties presented, and are experimenting and improving as rapidly as possible, the net returns on their investments in toll lines evidently warranting their best efforts." On studying the figures obtainable, Mr. Hibbard found that an average of 20 messages per day each would be nearly correct, as representing the present work of what are called 'busy' wires. At an average rate of 25 cents per message, and at a cost of $75 per mile, such a line might be 133 miles long and pay 10 per cent. on the investment. With a system of five wires, averaging 10 messages each, the limit of 10 per cent. profit would be 66 miles. "The present approved telephone line, for single wires, may be said to be of hard drawn copper wire, weighing from 100 to 300 lbs. to the mile, strung on glass insulators, with 30 cedar poles to the mile, the poles to be at least 25 feet long, 5 inches in diameter at the top and set 4 feet in the ground." Speaking of induction effects on long lines, Mr. Hibbard thought that the good working of lines and the freedom from induction noted so generally this summer were due to the long drought.

It appeared from the discussion, that, in general, little had been done to mitigate the induction evils. Mr. Ker had tried Van Rysselberghe coils, and Mr. Sargent the Jackson coils, and with fair results, the only objection being the lessening of the volume of sound—thinning it out, as it were. Mr. Sclater gave an encouraging account of the long-distance work done in Canada by his company, which is now earning on an average about 22 cents for each message. Their long lines were new ventures of the company solely, without any local help. Mr. Hall gave a few particulars about the long-distance line between New York and Philadelphia.* Some of the members doubted there being money in long lines, others quoted facts to the contrary, and many held that on such work there was practically no competition with the telegraph, for the reason that an entirely distinct and different service was given. Mr. Wiley Smith gave an interesting account of the highly successful long-distance work done in Kansas,† and spoke warmly in favor of solid, honest, liberal line construction. Comparison was then made of some of the methods in vogue for securing the fair charge for use of long wires and for the work done by the exchange. In this respect, a remarkable lack of uniformity was made manifest, every manager doing, apparently, as seems right in his own eyes.

On motion of Mr. Eastabrook, thanks for courtesies and hospitality were extended to Mr. Durant and the Bell Telephone Company of Missouri.

Mr. Cherry presented the following:

Resolved: That such of the present honorary members of this Association as may desire to be transferred from honorary to associate membership, may upon notifying the secretary of their desire for such transfer, and upon approval of the Executive Committee, be so transferred. Carried.

Mr. Durant presented plans of and read a paper on Col. Flad's electrophores, or lofty tower system for carrying wires at a great height.

The Convention then closed.

On Wedesday afternoon the members of the convention and their friends went, as the guests of the Bell Company of Missouri, thirty miles down the Mississippi, on the steamer "T. F. Eckert," to the plate-glass works at Crystal City. The trip was of a novel character and was very thoroughly enjoyed.

THE EXHIBITS.

The display of goods and novelties at the Convention, while not large, was certainly up to the average, and perhaps went beyond. The Western Electric Company was represented by Messrs. C. A. Brown, J. M. Jackson, W. R. Patterson and F. Harrington, but did not exhibit much, having in mind the intention of a large number of the delegates to visit Chicago before returning home, when, of course, the Western Electric factory would be inspected. Probably the factory was never so busy; it could hardly look more active than it did at the time the representative of THE ELECTRICAL WORLD passed through it just prior to the meeting at St. Louis.

The Standard Electrical Works, of Cincinnati, were represented by Mr. E. V. Cherry and Mr. Harry T. Crane, and had a compact exhibit of familiar productions and meritorious novelties, including the popular Hess hotel guest call and fire alarm, the new battery tester, the gelatine battery, etc. Great success appears to have been had with the Hess system, now in use in a large number of hotels, the imposing list of which is headed by the Plankinton House, Milwaukee, with 440 rooms. The little battery tester recently described in these columns attracted much attention, and when tried on cells in the room gave, invariably, prompt and trustworthy readings. Of the gelatine battery, made by the Cincinnati Electrical Company, Mr. Cherry stated in reply to numerous inquiries, that he regarded the results thus far obtained as favorable, and that he felt quite sanguine as to its future. Several telephone exchanges propose to give the battery a trial. Another novelty shown was the double contact plug for exchange boards, the patented invention of Mr. C. K. Mead, of the Central Union Telephone Company. It saves two motions of the operator on the regular multiple board, having a double conductor and a double contact. Yet another ingenious device shown in the parlor of the Works was Wright's reducer, described below.

Mr P. C. Burns made a neat exhibit on behalf of the Railway Telegraph Supply Company, Chicago, of which he is the St. Louis manager He had a full line of magneto bells, and an extension bell with switch combined, to be used at stations having a private line as well as an exchange line. Where this bell is employed, only one telephone is necessary. Mr. Burns showed also the A. S. Hibbard eccentric for line work, and the company's Leclanché batteries, the disc form being recommended for the long life of the porous cups, and the zinc form having an improved connector. The exhibit included samples of underground, aërial and submarine cables and insulated wire manufactured by the New York Insulated Wire Company.

The Brewer & Smith police visual signal and telegraph system was shown in practical operation, on the main floor of the hotel, by Mr. W. C. Smith, the superintendent of fire and police telegraphs, New Haven, Conn. An illustrated description is given in another column.

Mr. W. A. Childs had on view a new circular Law board with overhead drops, intended for use in cramped exchanges of 600 or 700 subscribers. It attracted considerable attention on account of its wonderful handiness and concentration of apparatus.

Mr. Clark B. Hotchkiss had a large and interesting exhibit of kerite cables, etc. His memento of the occasion, for distribution, was a neat little sample reel of kerite tape "for the lineman's pocket." From the way many pockets bulged, it seemed plain that the members had constituted themselves linemen pro tem; but perhaps it was silver dollars.

Mr. C. C. Jennings had an unpretentious but very effective display of Roberts-Brevoort batteries. The company manufactures the Roberts permanganate battery for open circuit work, the Roberts dry battery, noticed a few weeks ago in THE ELECTRICAL WORLD, and the Roberts peroxide battery, which is capable of very heavy and constant work. Mr. Jennings showed one of the latter running a bell for several hours, and then placed it on short circuit, without perceptible diminution of effect.

The Okonite Company was ably represented by Mr. Geo. T. Manson, with a neat and attractive selection of cables and wires, specially intended for telephone work.

Col. G. L. Beetle represented the American Electrical Works with his accustomed suaveness and ability. Colonel Beetle was ready for orders for any of the well-known products of his house, but took equal pleasure, in response to frequent inquiries, in showing a fine photographic group of the guests at the late "clambake of the year." The group looked very like a telephone convention on the third day of session.

Mr. Charles D. Wright, of Petersburg, Ill., gave personal explanations of his "reducer," now being manufactured by the Western Electric Company and the Standard Electrical Works. This reducer is a device for shunting the bell coils on telephone lines where there are a number of stations on the same line. It consists of a small soft-core magnet of about ten ohms resistance, mounted on a hard rubber base, and having for its armature a light spring which carries at its free end a platinum contact. The contact closes a shunt around the bell coils, thus reducing the resistance from 50 ohms to 10 ohms, and placing the small soft core magnet on the circuit in place of the polarized bell magnet while the conversation is going on. When a call goes over the line, the small soft core magnet is energized and attracts its armature, breaking the shunt and allowing the bells to come into circuit while the heavy current is passing. As soon as the call stops, the ringing circuit is open, and the talking circuit is remade through the shunt. The device is simple and effective, and was well spoken of by the telephone men present who had tried it. The cost of equipping lines with it is said to be very slight.

In spite of the great care exercised, telephone exchanges still have to do hard work for a great many deadheads, and are anxious to learn how to get an equivalent for every connection. Mr. Charles Wittenberg, general manager of the American Telephone Register and Toll Collector Company, of Indianapolis, has studied over the "deadhead" problem very assiduously, and as a result has produced a very ingenious system of protection and collection. The system was critically inspected at St. Louis by most, if not all, of the delegates. One of the Wittenberg devices is a register that when placed on the telephone will indicate up to 2,550 connections and begin again, the registering being done in full view of the subscriber as he uses the instrument. This register is made either as a dial or as a box. Another device is the toll collector, placed on the telephone. It permits the use of the telephone only after the toll has been paid, drops the money into a cash box, allows the return of the money by the intervention of "central" in case of no connection, and locks itself when the user leaves the telephone. A third device is the Wittenberg cabinet for public stations. In this the toll collector is modified, the same cash box being used for either, however. The door of the cabinet can only be opened on payment of the toll, and then closes itself. As before, if no work is done, the nickel or other coin can be returned by "central." Altogether, Mr. Wittenberg has given evidence of great ingenuity, and there is no reason why his inventions for toll collection should not find a wide field of use outside telephony, as well as be very largely availed of in it.

THE ELECTRICAL WORLD had as its headquarters a suite of three rooms on the parlor floor, near the main reception parlor, where the meetings were held, and was glad to entertain its friends there.

The Standard Underground Company, through its agent, Mr. F. Degenhardt, showed its well-known lead cables and wires. One novelty was a seven-conductor cable having what may be called "guard wires" imbedded quadrilaterally in the lead. The cable is chiefly intended for river crossings, where anchors drag, and for places where there is a liability to chafing. In case the lead around the conductors should be cut into, the guard wires, of steel or hard drawn copper, take the friction and the strain. The cable has great flexibility and can be made in lengths of 8,000 feet.

Mr. Henry D. Stanley, as the representative of the

---

* ELECTRICAL WORLD, July 10, 1886.

† ELECTRICAL WORLD, July 17, 1886.

Bridgeport Brass Company, had for the information of inventors a handy little folder, giving weight, resistance, breaking stress, diameter, and other points of hard-drawn copper wire, in B. & S., Birmingham and new British standard gauges.

Washburn & Moen presented members of the convention with their useful pamphlet, known as the "Handbook of Iron and Copper Wire in Electric Transmission." The work is now in its fourth edition.

The Christie "Telescope" Pulley.

Where a number of machines take power from a single line of shafting, as is frequently the case in electric light stations, a ready means of stopping one or more machines without interfering with the rest is necessary in order to guard against accidental interruptions. Various forms of pulleys have been designed for this purpose, but one of the most ingenious is that devised by Mr. Henry P. Christie, of San Francisco, Cal., and known as the "telescope" pulley. The latter has been specially constructed for high-speed service, and possesses the advantage that it relieves the belt entirely of duty when the machine is stopped.

The pulley is shown in perspective in Fig. 1, in which position the belt is unshipped. Fig. 3 shows the pulley in section in the same position; and Fig. 2 shows the pulley when in action. On the driving shaft *A*, the pulley *B* is mounted, being loosely keyed so that it can be swung back and forth by means of the clutch lever *D*, operated by the worm and wheel.

When it is desired to engage the pulley *B*, it is telescoped over the drum of stationary holder *C*, by means of the hand-wheel. The edge of the pulley being tapered, when it reaches the belt the latter at once rides on it in the same manner as a belt does on a crowning pulley, and the transfer from the stationary holder is easy. When in full duty the pulley is ¼ inch clear of the belt-holder. When not in duty it will be seen that the belt rests against the stationery belt-holder *C*, which may be secured in any position on the wall, floor or ceiling. The belt guide shown in Fig. 1, prevents any lateral motion of the belt. The device was mentioned at the late Electric Light Convention, where it elicited much favorable comment.

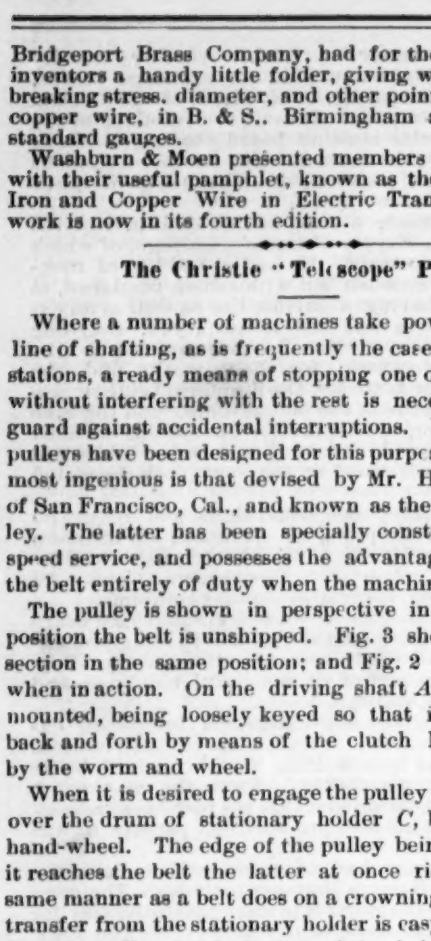


FIG. 2.

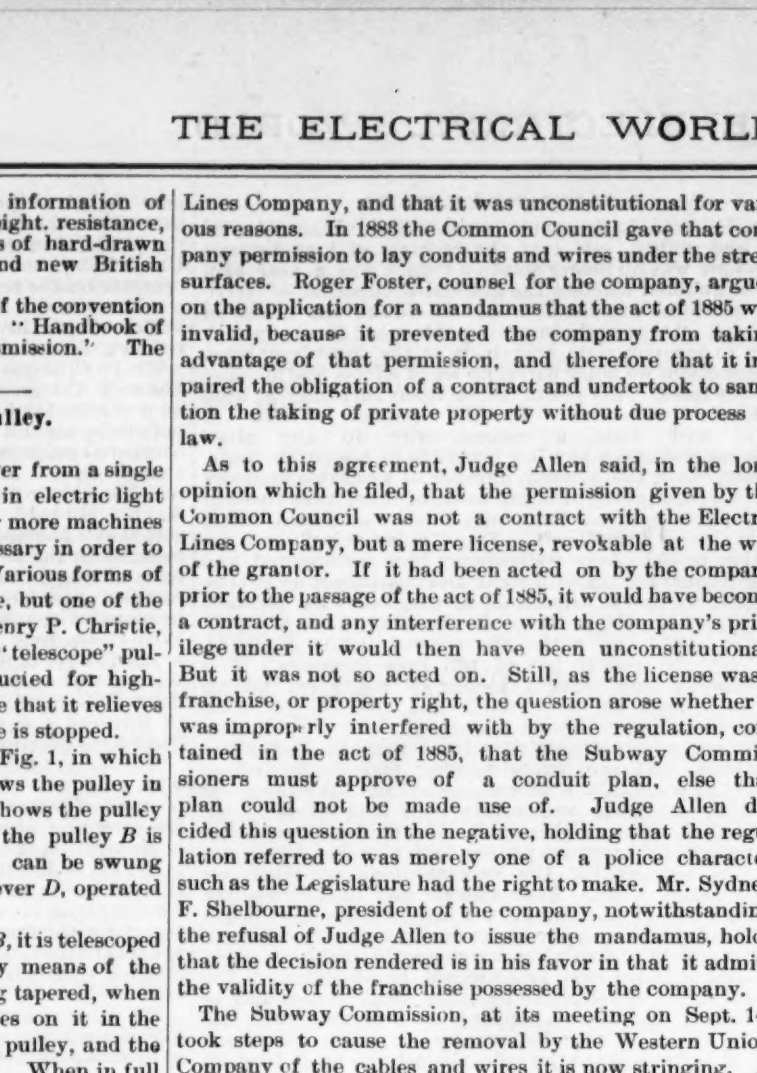


FIG. 1.—"TELESCOPE" PULLEY FOR DYNAMOS.

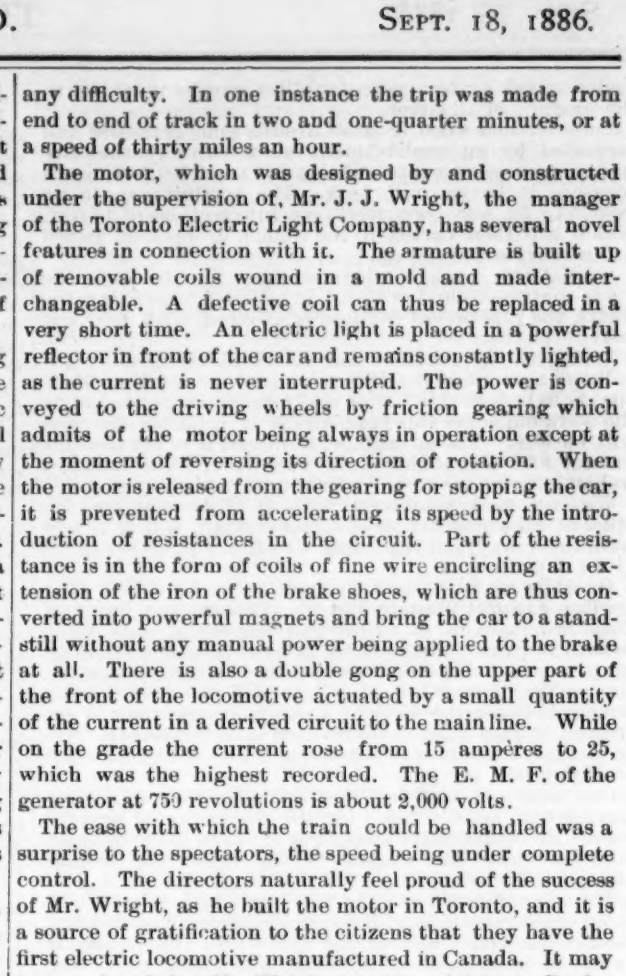


FIG. 3.

Progress of the New York Subway.

Work on the subway in Sixth avenue, in this city, is progressing somewhat slowly, due, it is said, to lack of facilities for turning out the sections of the duct; but new machinery which is now being added will, it is hoped, make the capacity of the works ample to keep pace with the opening of the trenches.

On Sunday, Sept. 12, the Western Union Telegraph Company began the stringing of cables under the elevated railway structures in this city, as forshadowed by us last week.

The Electric Lines Company having applied for a mandamus to compel the Commissioner of Public Works to issue to it a permit to open the streets on the ground that its franchise made it independent of the Subway Commission, Judge Allen last week refused to issue the order. The Commissioner of Public Works had refused such a permit because the Subway Commissioners had not approved the plan of the Electric Lines Company. The application for a mandamus was based on the theories that the act by which the Subway Commissioners were created did not apply to the Electric Lines Company, and that it was unconstitutional for various reasons. In 1883 the Common Council gave that company permission to lay conduits and wires under the street surfaces. Roger Foster, counsel for the company, argued on the application for a mandamus that the act of 1885 was invalid, because it prevented the company from taking advantage of that permission, and therefore that it impaired the obligation of a contract and undertook to sanction the taking of private property without due process of law.

As to this agreement, Judge Allen said, in the long opinion which he filed, that the permission given by the Common Council was not a contract with the Electric Lines Company, but a mere license, revokable at the will of the grantor. If it had been acted on by the company prior to the passage of the act of 1885, it would have become a contract, and any interference with the company's privilege under it would then have been unconstitutional. But it was not so acted on. Still, as the license was a franchise, or property right, the question arose whether it was improperly interfered with by the regulation, contained in the act of 1885, that the Subway Commissioners must approve of a conduit plan, else that plan could not be made use of. Judge Allen decided this question in the negative, holding that the regulation referred to was merely one of a police character such as the Legislature had the right to make. Mr. Sydney F. Shelbourne, president of the company, notwithstanding the refusal of Judge Allen to issue the mandamus, holds that the decision rendered is in his favor in that it admits the validity of the franchise possessed by the company.

The Subway Commission, at its meeting on Sept. 14, took steps to cause the removal by the Western Union Company of the cables and wires it is now stringing. A report, showing that the manufacture of conduits at the Dorsett Works was going forward as rapidly as possible, was received from Lieut. E. A. Benjamin, general inspector of conduits. The capacity of the works will be doubled this week. The Holmes Electric Protective Company asked permission to erect six poles in different parts of the city as posts for alarm boxes. Mr. Moss was unwilling to allow poles to be put up for any purpose. The matter was referred to the engineer. The Consolidated Telegraph and Electric Subway Company was directed to begin within 14 days the construction of a subway in Sixth avenue, from Twenty-third street to Carmine street, in accordance with specifications already made. Counsel for the C. H. O'Bryon underground conduit system asked for another hearing. He was referred to the engineer.

The Toronto Exhibition Electric Railway.

On Sept. 1 last a formal trial was made of the new locomotive built by the Toronto Electric Light Company for the above road. There were present President Withrow, of the Exhibition Association; Messrs. D. C. Ridout, Geo. Booth, Colonel Gray, Fred Nichols and other members of the Board of Directors; Mr. H. P. Dwight, General Manager of the Great Northwestern Telegraph Company, and a number of others, together with representatives of the press. The train consisted of three cars besides the motor car, each capable of seating fifty passengers. The trial trips were a perfect success. There is a considerable grade in one part of the road, but the train went over it without any difficulty. In one instance the trip was made from end to end of track in two and one-quarter minutes, or at a speed of thirty miles an hour.

The motor, which was designed by and constructed under the supervision of, Mr. J. J. Wright, the manager of the Toronto Electric Light Company, has several novel features in connection with it. The armature is built up of removable coils wound in a mold and made interchangeable. A defective coil can thus be replaced in a very short time. An electric light is placed in a powerful reflector in front of the car and remains constantly lighted, as the current is never interrupted. The power is conveyed to the driving wheels by friction gearing which admits of the motor being always in operation except at the moment of reversing its direction of rotation. When the motor is released from the gearing for stopping the car, it is prevented from accelerating its speed by the introduction of resistances in the circuit. Part of the resistance is in the form of coils of fine wire encircling an extension of the iron of the brake shoes, which are thus converted into powerful magnets and bring the car to a standstill without any manual power being applied to the brake at all. There is also a double gong on the upper part of the front of the locomotive actuated by a small quantity of the current in a derived circuit to the main line. While on the grade the current rose from 15 ampères to 25, which was the highest recorded. The E. M. F. of the generator at 750 revolutions is about 2,000 volts.

The ease with which the train could be handled was a surprise to the spectators, the speed being under complete control. The directors naturally feel proud of the success of Mr. Wright, as he built the motor in Toronto, and it is a source of gratification to the citizens that they have the first electric locomotive manufactured in Canada. It may be mentioned that Mr. Wright was an assistant to Profs. Thomson and Houston, in Philadelphia, in the early days of electric lighting, while they were yet experimenting with and perfecting their now well-known apparatus.

Power Required for Running Arc Lamps.

For some time past the Hartford Electric Light Company has run a circuit of street lights, seven miles in length and having forty-six lamps, by the Waterhouse system. The Waterhouse Company has claimed that under its plan the expenditure of power per light was about half a horse-power for each light of 2,000 candle-power. Recently, says the Hartford *Courant*, Mr. C. H. Atkins, of the Knowles Pump Company, of Boston, made a series of experiments to determine the exact amount of power used to run the forty-six lights on the circuit operated under the Waterhouse plan. Tests were made once in five minutes with a pair of Thompson steam engine indicators. They showed the average horse-power developed and used to be 31½. Friction in driving the engine and dynamo used, 4.88 horse-power, leaving 26 62 horse power available to run the forty-six lights. These figures put the horse-power used for each light at .58, or a little more than half a horse-power. Were the lights all near the electric station, forty-nine lights could be used with the same power. The experiments made by Mr. Atkins not only showed that the lights were run with a small expenditure of power, but that the engine was not working to nearly its full capacity, though estimated to be fitted to run only forty-five lights under the old system.

Opening of the Van Depoele Electric Railway in Detroit.

The electric railway on Dix avenue, Detroit, was opened for traffic on Aug. 31. Mr. Van Depoele witnessed the maiden trip of the electric car.

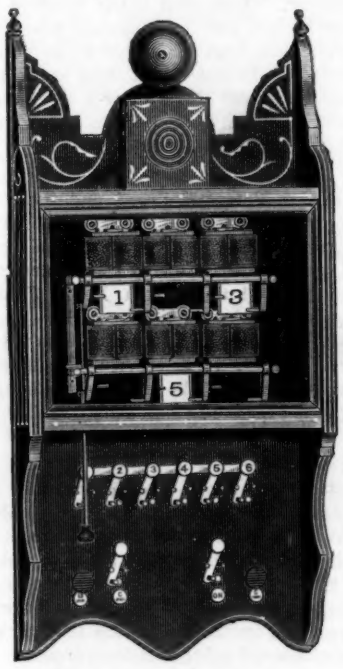
The motor, which is styled the "Van Depoele," in honor of the inventor, was hauled from the Antoine street barn by horses over the city railway lines in the morning, and connection made for the first trip about 1 P. M., when Mr. Van Depoele, accompanied by Manager Turnes, boarded the motor, the former grasping the lever.

Full speed was not attempted during the afternoon, owing to the fact that numerous small boys who followed the motor up and down the lines kept the track covered with sand and the gauge is not perfect at every point. The passenger cars, two in number, were connected to the motor about 5 P. M., and the full train then made its first trip successfully.

The motor, fashioned out of one of the smallest of the old City railway cars, is ten feet in length, and will be used as a smoker. Its weight is 10,000 pounds. The train has a carrying capacity of 100 persons, and it is estimated that a round trip can be made in fifteen minutes, although the schedule time will be about thirty minutes.

A Novel Burglar Alarm.

Our illustration represents a new form of burglar alarm recently introduced by the Electrical Supply Company, of this city. It is provided with the usual devices for testing the battery and the silent test for an open window or door, but its main feature consists in the fact that it operates entirely without springs. The annunciator drops are pivoted



NOVEL BURGLAR ALARM.

horizontally, and are maintained in position by a latch attached to an armature; when the latter is attracted by its magnet the latch is withdrawn and the drop falls to the vertical position as shown in the illustration.

The gravity principle has also been extended to the rod which replaces the drops, as it falls to its original position by its own weight.

The same company also make the ordinary annunciators on the same principle, the absence of springs making them little liable to get out of order.

The Commercial Union Telegraph Company.

At a meeting of the stockholders of the Commercial Union Telegraph Company, held Sept. 9, at the company's office in Albany, N. Y., the following directors were elected for the ensuing year: Henry Russell, C. H. Abrams, C. E. Arnold, E. J. Slattery, of Albany; Ira Allen, of Fairhaven, Vt.; Henry Rosener, A. B. Chandler, George G. Ward, Hector Decastro, of New York. At a subsequent meeting of the directors the following officers were elected for the present year: President, Henry Russell; Vice-President, Ira C. Allen; Secretary, E. J. Slattery; General Manager, C. E. Arnold. This company makes exclusive connection with the Canadian Pacific Telegraph Company at Richford, Vt., and the immense business of that company destined for points in the United States is now passing over the wires of this company.

Electric Photography.

Dr. Boudet has presented to the *Société Internationale des Electriciens* an account of a series of experiments with which he has recently been occupied, and which has led him to devise an interesting method of reproducing designs of a certain class by electricity. Dr. Boudet builds up a condenser, of which a single sheet of metal forms one coating; a gelatino bromide film, mounted on glass, in the usual way, forms the dielectric, and the object whose image is to be taken occupies the place of the second coating. If this object be not a conductor, a sheet of metal is placed behind it. The condenser is then charged from a Voss machine, or other source of high-tension electricity. After discharge the plate is developed in the usual way, and the photographic image is found upon its surface. The most suitable objects for this treatment are metallic plaques, either engraved, etched, or stenciled; but by means of placing a second metallic surface at the back, Dr. Boudet has obtained very fair pictures of ivory miniatures and similar objects, and he has even produced pen and ink drawings with some degree of success.

The "Perfection" Iron Box Bell.

The above is the name of a vibrating bell recently designed and patented by the Boston Electric Company. As

NEW IRON BOX BELL.

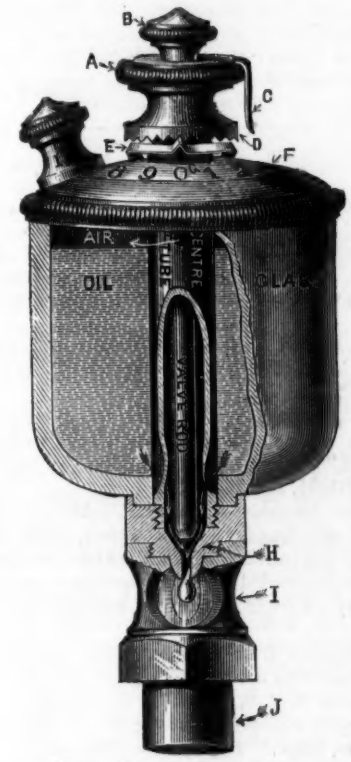
will be seen, the mechanism is contained within an iron box, having one side open. The magnets are screwed directly to the sides of the box, which, being of iron, forms a magnetic yoke between the two and keeps them firmly in position. The cover has a flange which constitutes the remaining side of the box, and is held in position by a single screw. By loosening the latter the cover can be slid back and the bell mechanism readily inspected. The box being of iron, with all the working parts rigidly attached

POLICE VISUAL SIGNAL.

thereto, no displacement by change of temperature or other causes can take place, and hence the bell is thoroughly reliable and remains constant in its operation.

A New Police Visual Signal.

The employment of the telephone and telegraph signal boxes in connection with the police arrangements of our larger cities is rapidly advancing, and the results obtained by this quick method of communication between each man on duty and his headquarters have often proved of great value. One of the latest devices in connection with such a service is that exhibited by Mr. Wm. C. Smith at the St. Louis meeting of the National Telephone Exchange Association. Our illustration represents a signal station as equipped on the system of Messrs. Brewer & Smith, and for some time past in successful operation at New Haven, Conn. This signal station is about eight feet in height, octagonal in shape, and of hollow construction, and midway it enlarges into a cast-iron box sufficient in size to contain a telephone and electric call-box, together with the apparatus for operating the visual signal. On the top of the station is placed the usual public lamp. Inside and above the call-box is an apparatus with counter-balance weights, which hold in position a concealed glass globe of red or any other color. Radiating from each station house are telegraph lines running through to these signal-box stations, either separately or in circuits. By the touch of a button at headquarters, an armature is released, and the red globe at once rises from inside the alarm box which encircles the gas or electric light. The change of color is seen by night on a street for a long distance, and in the daylight the colored signal can be seen for some blocks. The patrolman on his beat is thus notified that communication with headquarters is desired, and promptly responds through the telephone from the signal station to which the signal alarm has called him. After communicating, the colored glass globe is allowed to drop to its place of concealment. In the same manner the central office can communicate to any patrolman on his beat, or



DROP SIGHT FEED OILER.

the latter can summon assistance from any adjoining beat by opening the iron box, and by a touch releasing the armature which controls the ascent of the colored glass.

It will be seen that the system possesses some excellent features that should recommend it for general adoption.

Adjustable Drop Sight Feed Oiler.

It has come to be looked upon as an absolute necessity for the uninterrupted and economical working of quick-running machinery to provide means for continuous lubrication of the working parts. In order to be able to ascertain at all times if the lubricating devices are working properly in their supply, and regulate the same according to requirement, Mr. John S. Hall, of this city, has designed the oil cup shown in the accompanying illustration. The oil is fed drop by drop through a valve *H*, which can be closed entirely by the valve rod in the centre of the cup. This rod is attached to the milled nut *A*, which is held in position by the spring *E*, bearing against the ratchet *D* on the under side of the nut. In addition, the latter carries a pointer *C*, which ranges over the figures engraved on the brass cover of the cup. When the pointer is opposite zero, the valve is closed and no oil flows; but by moving it opposite the several figures, corresponding quantities of oil are fed. In this way the supply of oil can be regulated to a nicety; when the machine is stopped, the valve can be closed entirely, and, upon starting up, immediately reset to its proper feed.

The oil, as it feeds, drops through the glass tube *I*, and hence a constant indication of its working is afforded.

Magnesium by Electrolysis.—Magnesium, which has more than once been abandoned as a source of light, appears likely to be tried again, a process having been discovered for producing pure magnesium by electrolysis, and at a price much less than that at which it was formerly obtainable. At the works in Bremen, where the manufacture of magnesium is carried on, prizes are offered for the construction of the best magnesium lamps having clock-work movement.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, Sept. 13, 1886.

Telegraphic apparatus will soon be added to practically, in the shape of the new sextuplex, lately invented by Mr. Stephen D. Field, who, after a long spell of sickness, is himself again. I met Mr. Field in the city last week, looking as youthful as ever. He has been trying the sextuplex with a dynamo run by a Shipman engine, and says "it worked like a charm." He is about to make further essay in one of the telegraph offices. J. H. Bunnell & Co. are making his apparatus for him. The same house has, by the way, been turning out lately some very good test instruments.

Mr. H. N. Curtis is fitting out the Clyde line steamer Santo Domingo with a 50-light Thomson-Houston incandescent plant, and a 6,000 c. p. focusing arc lamp to run from the same machine. He is also increasing the Yonkers Thomson-Houston arc plant from 60 to 90 lights. Mr. R. S. Alexander, the local manager, feels highly gratified with the success of the plant. Mr. Alexander is another example of the way in which telephone men are coming into the larger fields of general electrical application. He is not only interested in the electric light, but in the Westchester and Hudson River telephone companies, and can often be seen bicycling his way from point to point in his territory.

Holmes, Booth and Haydens are finding the briskest kind of a market for their Austrian cored carbons. Some time in October, the new machinery of the Forest City Carbon Company will be ready, when the product of these cored carbons will be increased to 40,000 pair each day, or one million per month. It will, of course, be understood that only the positive or upper carbon is cored. The lower one remains solid as before.

The Brush-Swan Electric Light Company, of New England, since they were burned out in conjunction with the Brush Illuminating Company, at 204-210 Elizabeth street, have been temporarily located at 479 Broadway and 52 Mercer street. Mr. Gaylord McFall, the secretary, and Major J. B. Powell, general manager, both inform me that the demand for their system was never greater than during the past week. They will retain their present offices until further notice, as the question of location for the new station is not yet settled. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Sept. 13, 1886.

The Synchronous Time Company, of this city, has added an illustrated supplement to its handsome catalogue, representing the various devices, movements, clocks and electric dials of its system.

The American Bell Telephone Company will pay its regular quarterly dividend of $3 per share on Oct. 15 to stockholders of record July 15, 1886.

Information has been received that the Western Union Telegraph Company has purchased 20,000 Carhart aërial cable clips. This useful, durable and economical device is manufactured by Mr. E. M. Carhart, Providence, R. I.

The Putnam Machine Company, Fitchburg, are building a wing to their old foundry, 150×60 feet, which will hold 150 workmen. It will be fitted with all modern appliances, and will afford them much-needed room in other departments. This concern sent away six engines last week, and are busy in this branch of work.

A recent dispatch from Quincy, Mass., reported as follows: "The telephone wires between this place and Weymouth, Mass., were all down on Sept. 8, caused by the breaking of two poles. Eleven lines were obstructed, cutting off all communication below East Braintree, Mass." Repairs are being made.

Mr. James H. Howard has retired from the board of Directors of the Chemical Electric Light and Power Company, and Mr. John H. Sturgess has been elected to fill the vacancy. Mr. Howard's large business interests abroad now demand more of his time and attention than heretofore, and this is his reason for retiring from active work in the enterprise referred to.

The Union Club of Boston, composed of many of the most distinguished citizens of the "Hub," has introduced incandescent lighting in the temporary club rooms on Somerset street. The system used is that of the New England Weston Electric Company, the lamps being the "Mogul," of 125 c. p. each. The club will not return to its palatial building on Park street until after repairing, refitting and refurnishing.

The Citizens' Electric Light Company, operating the American system in East Boston, Chelsea and Revere, joins the ranks of dividend payers, paying 2 per cent. quarterly, Oct. 1. Its earnings have been unexpectedly large during the summer, notwithstanding the fact that the general manager, Mr. Edward S. Sears, voluntarily reduced the prices of lighting to all the company's customers May 1. His opinion that such action would increase the number of lights burned during the summer sufficient to offset the reduction in rates has been more than justified by the result. The plant is running nearly up to its full capacity, and the net earnings are increasing each month.

At a meeting of the Malden (Mass.) Aldermen, on the evening of September 7, the committee on street lighting was authorized to contract with the local electric light company for a number of arc lights. Poles and wires for these lights will be erected at once on Pleasant and Salem streets.

The Lynn (Mass.) Electric Light Company, which, by the way, owns one of the finest and best equipped plants in New England, has begun to introduce incandescent lights. Up to July 1 this company was operating 300 arc-lights, city and commercial combined, but the growing demand for incandescents by the business men encouraged the introduction of a Thomson-Houston 300-light incandescent dynamo. So eagerly has this mode of lighting been sought after, that the entire capacity of the new machine is now in use, and the company contemplates purchasing another.

In my notes in issue of Sept. 4, I erroneously wrote the initials of the president of the Benedict & Burnham Manufacturing Company as "E. L.;" it should have been written Mr. Charles Dickinson. I am informed that Mr. Dickinson is expected home from his European tour the last week in the present month, or the first week in October. Mr. H. C. Hayden, the New England agent of the Benedict & Burnham Manufacturing Company, 24 Oliver street, Boston, reports the business of the concern as having been very satisfactory during the past month, particularly so in that branch of the business pertaining to wire and brass goods for electrical purposes.

Messrs. Blodgett, Bros. & Company, of this city, are known from Maine to Texas, and from New York to San Francisco, as being among the leading manufacturers of annunciators for hotels, clubs, residences and steamboats. For nearly a quarter of a century the firm have made a specialty of this branch of the electrical business, and have always retained the enviable reputation of being makers of only the more desirable grade of goods in the line referred to. During a recent interview with the senior member of the firm, my interlocutor remarked: "Our trade in annunciators is steadily increasing; our orders for these goods during the past six months exceed the number received the whole year previous."

Messrs. Olney Brothers, the well-known oil manufacturers, received a handsome and justly deserved testimonial from the editor of *The Manufacturers' Gazette*, issue of June 19, 1886, from which I take the following: "The oils sold by Messrs. Olney Brothers, of 140 Congress street, Boston, and 7 Water street, Providence, R. I., are moderate in price and have stood the test of trial against the highest-priced article in their special line in some of the largest engines, and on some of the heaviest machines in the country. They have been triumphant even when they have not only had to compete with rival oils, but against the prejudices of engineers and other operatives. The Messrs. Olney have been selling these oils for fifteen years, and the first customers they have sold to are now using these oils, and this one fact in itself, in these times of fierce competition, is a solid recommendation."

I have recently had occasion to examine the "Climax" splicing tape made by the Boston Rubber Shoe Company, of No. 245 Causeway street, this city. It is pronounced an excellent article by all who have used it, among the number being some of the leading electrical companies. As a well-known electrician has said, the needed qualifications of such a tape covering are twofold. First, it must be a good moisture-proof insulator, and second, it must before application possess a glutinous or viscous surface adapted to become dry when applied without peeling off and unwinding. This tape possesses both these qualities in a high degree, being made of a stout fabric of cotton or linen material, impregnated with india-rubber specially prepared.

The tape evidently makes an excellent covering for telegraph, telephone and electric-light wire joints, and can be generally applied to the additional insulation of adjacent wires in dynamos and other electrical apparatus.

The Jarvis Engineering Company has just closed a contract for the entire steam plant—engine (Armington & Sims), boiler, injector and heater—with the Natick (Mass.) Electric Light Company. The boiler will be set with Jarvis setting, and National rocking grates to burn coal-dust and waste leather scraps for fuel. The Thomson-Houston systems of arc and incandescent lighting will be used by the Natick company.

From what Mr. Burnham tells me, I judge that more than ordinary interest will attach to the advertisement he intends inserting in your issue of Sept. 18 relative to the Electric Gas-Lighting Company of Boston.

The Siebert Cylinder Oil Cup Company, of 53 Oliver street, Boston, manufactures an automatic sight-feed lubricator which shows the oil as it enters the engine or dynamo machine, drop by drop. This company was incorporated in 1878, and its aim from the start has been to manufacture, in the principle evolved as well as workmanship, the best sight-feed lubricating device for all kinds of steam cylinders. Recently the company obtained control of a number of patents of different devices for oiling or lubricating the bearing surfaces of engines. Some of these have been perfected and are now offered to the trade. The handsome catalogue "E," issued gratis by the company, gives full description, with illustration, of all these useful devices. W. P. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, Sept. 11, 1886.

The telephone convention, following so closely after the electric light meeting, has come and gone, and the larger part of the delegates and visitors are already back at their homes. Some dozen or fifteen, however, are spending a few days in Chicago, before returning to business and everyday affairs. Inasmuch as the convention was held in one of Chicago's suburbs, it was thought the eminently proper thing by a car load of the delegates to take a run into the city itself, before leaving for good. By the kindness of the Chicago & Alton road and the efforts of friend Harrington, an entire sleeper was placed at the disposal of those wishing to come to Chicago; and the opportunity was embraced by seventeen of the delegates. What a pleasure, what a relief, after escaping from St. Louis' hot temperature, to find one's self again within the influence of Lake Michigan's cooling breezes! St. Louis—hot, depressing, enervating; Chicago—cool, pleasing, invigorating. The change is like passing in a night from Africa to Greenland.

Mr. George F. Durant, however, is not to blame for St. Louis weather, for there was nothing in his power that he could do for the entertainment and comfort of the delegates that he did not do. With that hospitality so characteristic of Western people, he applied himself unceasingly to administering to the wants and pleasures of his visitors, and that he succeeded in this direction the many remarks of approbation heard concerning his efforts and liberality bear ample witness.

Mr. Durant's new exchange was visited by nearly every delegate present, and its satisfactory working admired by all.

At the telephone meeting, I noticed what I had observed the week before at the electric light convention, that notwithstanding the fact that the convention was held in the West, fully fifty per cent. of the attendants were from the East. This was very gratifying to the Western members, and they will endeavor to reciprocate by keeping their end well up at Philadelphia and Pittsburgh next year.

The Telephone Association is the older institution, but it will have to look to its laurels. There was a larger attendance at the electric light meeting in Detroit than at the telephone convention in St. Louis.

There is a telegraph operator in the Baltimore & Ohio office at the Board of Trade building here who looks as much like Bob Ingersoll as anybody could who had any hair on the top of his head. The orator hasn't any hair. The telegraph operator has. But the latter has his distinguished prototype's bland and childlike features, his chin, his nose, and the same shaped head. The Baltimore & Ohio man, clad in a linen duster, stood out in the Board of Trade alley one hot afternoon this week when a gentleman who knows Pope Bob well stopped in amazement and pointed out the wonderful similarity. The telegraph operator stood the scrutiny quietly. The resemblance, he said, had often been noted before. His name is Morrow, but he answers either to the sobriquet of Colonel Bob or Pope Bob just as quickly. W. A. K.

THE TELEGRAPH.

A Reminiscence.—Forty years ago a New Jersey railroad refused permission to Henry O'Reilly, the competitor of Morse, who died recently in New York City, to erect posts and build a telegraph line along its road from Washington to New York on the ground that "the telegraph would interfere with travel, by enabling persons to transact business by its means, instead of using the railroad."

An Operator Murdered.—A dispatch from Marshall, Ill., of Sept. 13, says: "George Powers, a telegraph operator, and agent of the Vandalia Railroad, stationed at a lonely spot near here, was assassinated Saturday night by some one who fired at him through a window as he was writing. The murderer robbed his victim of a gold watch, and about $15 in money. There is no clew to the assassin. Bloodhounds have been sent for to Indianapolis and Olney, Ill."

A Signal Tower Blown Up.—On the night of Sept. 10, a signal tower at Chicago, on the Lake Shore Railroad, was blown up. The operator was hurt, but not seriously. A search of the tower was rewarded by the finding on a lower floor of a twenty-inch piece of shattered gas-pipe. Close to it was a smoking package of something which looked like cotton soaked in some dark liquid. A bottle containing what is supposed to be an acid was picked up near by. Thirty-four of the hundred battery jars in the cellar were broken, and the pneumatic tubes, also used in signaling, were torn and twisted and the whole system was utterly ruined. It will take thousands of dollars to repair the damage. In a little shed at the rear of the tower a small bundle, supposed to contain another explosive wrapped in a mattress, was picked up. It is said strikers did the work.

Railway Telegraph.—A contract has recently been signed between the Lehigh Valley Railroad and the Phelps Induction Telegraph Company for the application of the Phelps system of railway telegraph to the entire system of road operated by them. The work of equipment has already begun, and the first section of about one hundred miles from Perth Junction to Mauch Chunk will be in operation in a few weeks. The wires will be worked duplex, being used as ordinary Morse wires for local telegraph business and for train service simultaneously. All the regular passenger trains will be provided with an operator, and people going west over the Lehigh Valley road will soon be able to communicate with their friends and places of business while traveling at the rate of fifty miles an hour.

Dishonest Operators.—The Minneapolis *Tribune* makes some very damaging accusations relative to the methods employed by Western Union telegraph officials to fleece grain brokers of the cities of Minneapolis, St. Paul and Duluth. It appears from these statements that operators, in some instances with the connivance of office managers, have systematically manipulated market quotations in the interest of cliques composed of themselves and other dishonest traders. This is claimed to have been accomplished by withholding messages, giving changes in the quotations in the Chicago markets until deals could be placed for themselves with brokers in the cities mentioned. Then the new quotations would be sent out and these dishonest deals immediately closed. There has been common complaint for several months that quotations have been repeatedly held back in the St. Paul office, often for a quarter of an hour after important changes have been noted over private wires. So far as reported, no very large sums have been made at any one time, but, the system having been in operation so long, the aggregate earnings should be considerable.

THE TELEPHONE.

Tacoma, Washington Territory, is subscribing capital for long toll lines and for connection with Seattle.

Brooklyn.—The police patrol boxes, of which sixteen are now in use in the city, are pronounced a perfect success by Mr. Campbell, the Superintendent of Police.

Newburgh, N. Y.—The Hudson River Telephone Company a few weeks ago began proceedings against the Schuyler Electric Light Company, which is putting in a plant at Port Jervis, to enjoin the electric light company from erecting its poles and stringing its wires in such close proximity to the telephone wires and poles as to impair the usefulness of the latter. Judge Brown, of the Supreme Court, at Newburgh, first granted a temporary injunction against the light company, and on Saturday, the 4th, at a hearing he made an order granting a modified injunction, which prevents the stringing of the electric light wires close to those of the telephone company pending the trial. The trial of the case is deemed to be important, as it is believed that it will determine the law applicable to two useful inventions.

THE ELECTRIC LIGHT.

Ottumwa, Ia.—The Ottumwa Electric Light Company is announced with a capital stock of $60,000.

Knitting Mills.—An Edison plant of 150 sixteens goes into the Rockton Knitting Mill at Little Falls, N. Y.

Newton, Mass.—The Newton Electric Light and Power Company has been organized. Capital stock, $25,000; all paid in.

The American Gas Company, of Peru, Ind., has been incorporated, with $60,000 capital, to manufacture both coal gas and electricity.

The American Institute Fair will have Edison incandes-

cent lights and United States arcs. The fountain will be illuminated by Edison lights.

The St. John (N. B.) Gas Light Company at their last monthly meeting resolved to operate an electric light plant in connection with their gas-works.

Southern Gingham Mills.—The Bibb Manufacturing Company, Macon, Ga., has contracted with the Westinghouse Electric Company for two incandescent electric light plants in its gingham mills.

The Burlington (Vt.) Gas Light Company have decided to purchase a controlling interest in the stock of the Brush-Swan Electric Light Company, of Burlington. Upward of fifty street lights and twenty commercial lights will be about the extent of the initial service.

Pittsfield, Mass.—The new incandescent electric light company at Pittsfield, Mass., has bought a lot for $7,000, and commenced a new building for its dynamo, 20 × 40 feet. The Pittsfield Electric Light Company met recently to see about adding incandescent lights to its system, but reached no conclusion.

Friendship, N. Y.—Mr. George A. Mayo, the electrician of the Enterprise Electric Company, is putting in several hundred incandescent lights run from dynamos of his own design and construction. Last month, in the same locality, he sold four 3-light arc plants, and this month has sold two 25-light incandescent plants. His new 25-light arc machine is nearly ready for testing.

"Distribution Wiring."—With reference to the description given of this system of wiring by Mr. T. C. Martin before the National Electric Light Association, at Detroit, our attention is called to the fact that a patent, No. 343,087, covering the methods was granted June 1, 1886, to Mr. L. Stieringer and Mr. J. H. Vail, under the title, "House Wiring for Electric Lights." The patent has thirteen claims of a broad nature, and is illustrated by four sheets of drawings. The application for this patent, under which, therefore, it would appear such wiring can be operated, was filed July 1, 1884.

Too Much of a Good Thing.—A special dispatch of Sept. 8 from Washington says: "When Congress made the appropriation for the electric light at Hell Gate, it was supposed that the problem of lighting that dangerous passage and inland waters had been solved. But the deliberations of the Lighthouse Board here yesterday seem to throw great doubt upon the adaptability of electricity to this purpose. The quarterly session of the Lighthouse Board, just closed, was largely occupied in discussing the question of electric lights as applied to the lighthouse service. Protests of the most emphatic character were received from the maritime interests of New York against the maintenance of the electric light at Hallett's Point, which is the only one in the service. Captains and pilots state that it blinds them and renders them unable to measure distances—so much so that tugs with heavy tows refused to pass it at night. The Board seems to be in favor of discontinuing the light." A better course than discontinuance could easily be found, if sought.

Indianapolis.—The Jenney manufactory in West Indianapolis is one of the busiest places imaginable these days, for they have more orders than they can well fill, and are at present engaged in moving into larger and better quarters. The reputation of their light, both the arc and incandescent, has spread so rapidly that their facilities are tested to the utmost to answer the demands made upon them. Theirs is the only electric lighting company which manufactures all the appliances used in connection with the light—the dynamos, arc lamps, incandescent lamps, motors, regulators, electric light towers, mast-arms, etc. Their arc light, which is used for out-door illumination, is very superior, and is now in use in lighting the streets of San Diego, Cal., Waco and Corsicana, Tex., Clarksville, Tenn., Saratoga Springs, N. Y., Madison, Michigan City, Martinsville, Greencastle, Bloomington, Brazil, West Indianapolis and numerous other places. In the city, beside the *News* office, Schmidt's brewery and the Indianapolis Paper Company, are thus lighted. A writer in the *Evening Herald*, of Madison, says that the people there are particularly well pleased with the light, because it lights up the city much better than was done by gas, which cost $7,652.45 per annum, while the Jenney light costs only $3,600. Any person who is interested in such matters, by going over to West Indianapolis at night, can see how brightly the streets are lighted by the Jenney lamps, and they are as bright and steady far away from the works as they are near it. Electric light apparatus is necessarily delicate, and great care is necessary in its manufacture. Mr. Jenney himself gives his personal supervision to the work, and he is assisted by Mr. James Gilliland, an experienced electrician, Mr. Brainard Rorison, the secretary of the company, and others. A large force of men are engaged all the time, and the works have every indication of prosperity.—*Indianapolis News.*

APPLICATIONS OF POWER.

South Framingham, Mass., has been considering the adoption of the Chandler aërial transportation system, but has not yet made up its mind on the subject, some opposition being expressed in regard to the proposed route.

A Trip Across the Channel.—On the 13th inst. Mr. Reckenzaun's electric launch "Volta" made a trip across the English Channel from Dover to Calais and back, a distance of about 50 miles. Storage batteries were employed as the source of power, and the trip was highly successful in every respect. The batteries were charged but once.

Boston, Mass.—The Merchants' Electric Light Company, Boston, has orderd a 125 horse-power Armington & Sims Company engine. The power from this engine will be transmitted over wires to run Sprague motors all over the north end of Boston. It will furnish power for printing presses, sewing machines, ventilators, fans and both freight and passenger elevators. By the means of this most wonderful system attics and lofts can be made as valuable as lower floors. It is only a question of time when thousands of horse-power will be used in this city and all transmitted over a wire.—*Boston Journal of Commerce.*

Detroit, Mich.—Mr. W. A. Jackson, the well-known telephonist, of Detroit, is prominently interested in a new electric railway that will run from the outskirts of the city to an embyro suburb, two and one-half miles out. The track is laid with small central rail, and the station is built and equipped. The road will go into operation about Oct. 1. The motor to be used is understood to be the design of Mr. Fisher, of the Detroit Electrical Works, a young electrician of great ability. Mr. Jackson has had the station fitted up in a manner that has no parallel for completeness and efficiency in electric street railways in this country. Next year, the same parties will have another electric railway six miles long, running around the pretty pleasure resort known as Belle Isle, which is to be connected with Detroit by a bridge.

PERSONALS.

Mr. Frank Shaw, whose health has been bad for some time, proposes to recuperate with the help of the bracing air of a Minnesota autumn.

Prof. T. C. Mendenhall will publish shortly, through Houghton & Mifflin, a work entitled "A Century of Electricity," dealing with the chief inventions in the electrical field.

Mr. W. D. Sargent, of the New York and New Jersey Telephone Company, does not return home immediately from the St. Louis Convention, but takes a trip on to Kansas.

Mr. A. S. Hibbard, of the Wisconsin Telephone Company, joins the force of the American Telephone and Telegraph Company. He will have excellent opportunities to put to account his great experience in long-line work.

Mr. Roswell P. Flower is Mayor Grace's "first choice" as next mayor of this city. "He is a rich man, young and a brilliant financier. He is a self-made man. He is scrupulously honest. He would protect the finances of the city, simplify the business and actually reduce our city debt of $119,000,000."

MISCELLANEOUS NOTES.

Curb Conduits.—The Campbell Curb Conduit Company, of Minneapolis, is announced with a capital stock of $4,000,000. Mr. M. Ball is its President.

A Big Clock.—Buffalo is going to have the largest clock in the world—or one at least as large as that for New York. The dial will be twenty-five feet in diameter, and the centre of the dial will be 361 (?) feet above the street. The dial will be illuminated by electricity, and it is calculated that the time can be seen at night from any point in the city, and with a field glass the position of the hands can be distinguished at a distance of fifteen miles.

Lightning and Oak Trees.—Percy Smith, writing on the liability of trees to be struck by lightning, says: "The suggestion that oak trees are struck because they contain iron is both erroneous and absurd. If oak did contain iron it would, in all probability, increase its conducting power and act as a preventive. If oak contained an estimable quantity of that metal the wood would turn black on exposure to the air, on account of the tannin which is present. The blackening may be seen surrounding the iron nails in any oak fence. The contour of the ground, nature of the soil and the presence or absence of water have more influence in deciding the locality of an electric discharge than the height of a tree. Add to this the difference in conductibility between various woods, and we have at once an explanation of the apparent peculiarity of tall trees escaping unharmed while shorter trees are destroyed."

Magnetism Produced by Condenser Discharges.—M. Claverie has made a series of experiments to discover how steel needles are magnetized by the discharge of condensers. He employed a battery of twelve jars, each having a capacity of $\frac{1}{150}$ microfarad. The needles were placed in a magnetizing spiral 13 millimetres in diameter and 300 millimetres long. The spiral consisted of wire $\frac{1}{2}$ millimetre in diameter, and the needle was 15 millimetres long. M. Claverie concludes that currents of very short duration, such as the discharge of condensers, magnetize steel conformably to the laws of Ampère. While the discharge continues the austral pole is to the left of the current. In the case of oscillating discharges the needle receives, at progressively decreasing depths, magnetizations in contrary directions alternately, the first penetrating to the axis and then disappearing. The resultant magnetization may be either in one direction or the other, according to the direction of the last of the magnetizations, especially those of the superficial layers.

SPARKS AND FLASHES.

Rough on Bald Men.—An English physician says that men shouldn't crop their hair short. Hair, he says, is a conductor of electricity to the brain, and if the brain fails to get electricity it will soon soften.

Too Busy to Talk.—"I have always understood," remarked a commercial tourist to the hotel clerk, "that women belong to the talkative sex?"

"Well?" queried the clerk.

"I have just been sending a despatch," explained the tourist, "and all I could get out of the young woman operator over there in the corner, when I inquired if she could send it right away, and how soon I might expect an answer, etc., was, 'Um—yum—twenty-five cents, please.'"—*Puck.*

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange and elsewhere are as follows:

Telegraph.—Western Union, b 67¼, a 67⅝.

Telephone.—Am. Bell, b 193, a 194; Erie, b 27; New England, b 40, a 41.

Electric Light.—No new quotations.

BUSINESS NOTICES.

Magnetism in Watches.—

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, *Manager Western Department.* 216 *La Salle Street.*

CHICAGO, Feb. 10, 1885.

Messrs. Giles, Bro. & Co.:

GENTLEMEN: I have now been carrying my watch encased in one of your Anti-Magnetic Shields for about a year, and it affords me pleasure to state to you that notwithstanding I have been very much about dynamo-electric machines during the time named, the anti-magnetic case seems to protect the watch perfectly from the magnetic influence of the machines. I have not made any special electrical tests, inasmuch as I regard the good running of the watch as all that is necessary. I am thoroughly convinced, from the effect upon my own watch, that the case is an excellent protection, and I may almost add an absolute proventive of magnetic influence from external sources to the delicate movements of a watch. My watch is a Howard watch, and during the period of two or three years previous to encasing it with your anti-magnetic case it had varied to a very great extent, and I had it demagnetized on two different occasions. I regard your case as a complete success, and if my indorsement of same is of any value, you are at liberty to use it.

Yours truly,

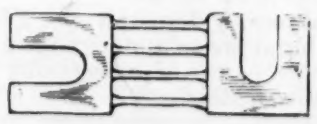
C. C. WARREN, *Manager Western Dept.,*
The U. S. Electric Lighting Co.

Important Change in Johnston's Patent Agency.—The business of Johnston's Patent Agency has steadily and rapidly increased ever since the establishment of that department, about five years ago. The increase during the past year or so has, however, been especially marked. It has always been and is our aim to do strictly first-class patent work, and with that object in view we have been constantly on the alert to add to our facilities, and to heighten in every way the efficiency of the Agency. Our very gratifying success heretofore has encouraged us to in a manner reorganize this department, and the business of the Agency will in future be under the personal supervision as manager of Mr. George H. Stockbridge, a competent electrician and a thoroughly trained patent attorney—in fact, a graduate of the U. S. Patent Office. Mr. Stockbridge, who is a brother of Mr. V. D. Stockbridge, formerly Assistant Commissioner of Patents, chose electricity as his specialty, and devoted his entire attention when in the Patent Office to inventions in that division. He had charge of a number of the sub-divisions in the Class of Electricity, and made examinations at various times in all of them, thus familiarizing himself with the whole range of electrical invention. In addition to his training in the Patent Office, Mr. Stockbridge has had a practical experience of two years and a half as a successful practicing patent solicitor in Washington. Clients of the Agency can therefore rest assured that their cases are in good hands. We have also in several other respects added to our facilities, and we now feel more confident than ever that electricians who give Johnston's Patent Agency a trial will not thereafter wish to have patent work done elsewhere. The following is what Mr. Kintner, Examiner of the Class of Electricity in the U. S. Patent Office, says of the new manager: "Mr. G. H. Stockbridge was associated with me in the U. S. Patent Office for more than two years as an assistant in the examining corps. He had charge of several of the sub-divisions of electrical devices embraced in the Division of Electricity, and is in every way competent to transact business before the office, from an expert standpoint as well as from that of a practitioner."

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED AUGUST 31, 1886.

348,227. Receptacle for Poisons; Theophilus Mayhew, New York, N. Y. The series of drawers containing the drugs are each provided with a latch, arranged so that in their normal condition the drawers will be secured in the frame, but may be unlatched and removed only one at a time. The locking mechanism of the several drawers or slides is formed and connected so that the movement of unlocking or removing one drawer will disconnect or block the mechanism for opening or removing those remaining. To prevent the removal of the wrong receptacle through inadvertence, the unlocking mechanism is constructed so that before it can be operated an index or other device must be moved or placed in an appropriate position for the drug or poison needed; and to so prepare for the removal of the drug from the case, it will be necessary for the person wishing the same to apply his mind directly to the operation. To still further guard against error, two separate indicating devices are used, both of which must be placed before the receptacle can be withdrawn from the case.



348,371.—SAFETY CATCH.

348,328. Mechanical Telephone; Bloomfield L. Kenyon Lee Centre, N. Y. The diaphragm is held by a series of bars and a bar of wood attached to the line presses against and across the diaphragm.

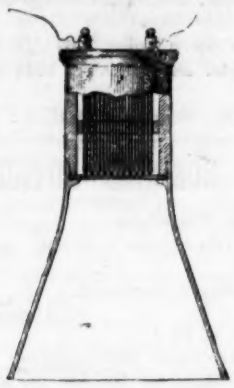
348,360. Electro-Magnetic Railway Brake; Ch. J. Van Depoele, Chicago, Ill. The invention consists in so arranging a system of brakes in connection with the motor by which the car is propelled that the brake-actuating magnet will be energized and caused to lift the brake-shoes away from the wheels when the motor is in operation, either during the run of the train or when it is desired to start; and when the current is cut off from the motor that it shall also be cut off from the brake-magnet, freeing the brake mechanism and allowing a weight or spring to set the brakes and stop the train or materially retard and regulate its speed.

348,371. Safety Catch; Wm. S. Andrews, New York, N. Y. Instead of making the fusible strip in one solid piece, the inventor employs two or more wires of the fusible metal soldered to common end plates of harder material, such as copper, as shown in

the illustration. The advantage claimed of using a number of fusible wires secured to common end plates over a solid strip of lead is that the conducting capacity of the catch can be more accurately determined. The conductivity of one strand of the fusible wire and its fusing-point with relation to the current being determined, a safety-catch, composed of a number of lengths of such wire, will be known to have a definite fusing-point with relation to the current, since the radiating surface of the safety-catch increases directly as its conductivity; but with safety-catches of different sizes, each composed of a single piece of fusible metal, the relative fusing-points of the several catches cannot be determined by their relative resistances, since the radiating surface does not bear the same relation to conductivity in any two of the catches.

348,385. Regulator for Dynamo-Electric Generators; Marcel Deprez and Jules Carpentier, Paris, France. The object of the invention is to regulate the generator at central stations for electric distribution, especially of power. The generator is excited by a separate machine, and in the circuit of the latter is placed a rheostat. To the line is connected a "tell-tale" motor, which carries a centrifugal governor operating upon the rheostat. When the normal condition of the line varies, the speed of the tell-tale motor is affected, and the governor operates the rheostat, so that the exciting current of the field-magnets of the generator is varied accordingly.

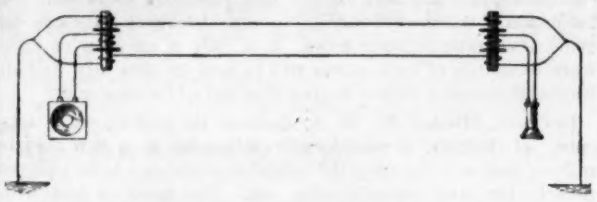
348,406. Medical Electric Belt or Pad; James McGrady and George H. Sloane, Boston, Mass. The invention consists in a novel arrangement of the zinc-copper elements.



348,501. THERMAL TELEPHONE.

348,407. Means for Suspending Electric Lights, or Gas, or Oil Lamps; John N. B. Moore, Hartford, Conn. The mast has a pulley at the top, over which passes a rope. A counter weight at the lower end balances the mast arm which carries the lamp.

(1) 348,429. Telephone Receiver; **(2) 348,430. Telephone Transmitter**; Louis Townsend, Evansville, Indiana, Assignor of (1) to Joseph L. Boy and Wm. B. Worthen, Little Rock, Ark., and (2) Assignor of one-half to the same. (1) He employs an annular split magnet, upon which the diaphragm rests. To the diaphragm is attached a core which enters a coil. (2) The object of the invention is to provide a telephonic transmitter having its vibratory contacts under the influence of a strong magnetic field, and to reduce the liability of derangement from rough handling, so that it can be used as a portable instrument. The handle consists of an electro-magnet having a soft iron tube as a core and wound with fine wire up to 600 ohms. The end of the tube is plugged by a solid piece of iron and its magnetic field extends to and influences a steel spring carrying one carbon button, and also the diaphragm carrying the other button.



348,512. TELEPHONE AND TELEGRAPH CIRCUIT.

348,437. Electro-Magnetic Adding Machine; Ch. W. Weiss, Brooklyn, Assignor to the Kruse Check and Adding Machine Company, New York, N. Y. An armature is pivoted between two electro-magnets, and a pole-changer alternately closes the circuit through one magnet and then the other.

348,455. Cut-out for Electric Circuits; J. M. Fairchild Portland, Oregon, Assignor of one-half to James O'Connor, of same place. The invention relates to a cut-out by which lights may be cut out without affecting the rest of the line.

348,456. Switch for Electric Circuits; J. M. Fairchild and James O'Connor, Portland, Oregon. The invention consists of an arrangement such that the switch can be employed either as a cut-out or the lamps switched from one circuit to another.

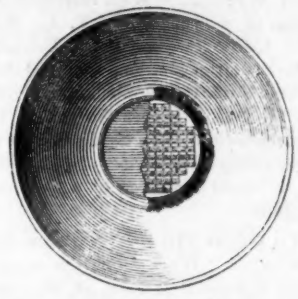
348,465. Medico-Electrical Apparatus; J. Randolph Hard, New York, N. Y. The invention relates to galvano-faradic apparatus, the novel features pertaining chiefly to the construction of the rheotome or circuit-breaker, and to the pole-changing and regulating switches.

348,476. Electric Railway. 348,477. Electric Railway; Sidney H. Short and John W. Nesmith, Denver, Col. 1. The main object of the invention is to dispense with the bare conductors, and consists, essentially, of a line or lines of insulated wire in connection with a suitable track, the conductors having exposed contact points between their section, and operating in connection with a motor and devices for taking the current from the exposed contact-points. 2. The invention relates to the non-conducting bar and its contacting-strips which are carried in connection with the motor or translating devices, and continually break the circuit of the main conductor and cause the current to be diverted through the motor or translating device. The invention consists of the special construction of the conducting-strips which are fixed to the insulated bar, whereby any short-circuiting of the current through the main conductor at the instant when the non-conducting bar with its strips is in connection with the circuit-closers of two sections is avoided.

348,482. Electrode for Electric Batteries; Silvanus L. Trippe, Denver, Col. The electrode of lead and zinc is cast around a frame of silver or copper wire, which gives it conductivity and keeps the peroxide from disintegrating and falling apart.

348,501. Thermal Telephone; Wm. Stanley, Great Barrington, Mass. The invention consists in combining with a thermo-electric battery means for varying the heat applied thereto correlatively with the variations in the air-waves. A convenient method of carrying out the invention, as shown in the illustration, is to support a diaphragm of some heat-conducting medium—such, for instance, as copper—near the battery, in such a position that it will approach and recede from the battery under the influence of the air-waves produced by sonorous vibrations or otherwise. The diaphragm is first slightly heated or warmed by breathing upon it, and the movements of this heated body, under the influence of the air-vibrations, will cause the battery to produce currents dependent upon the proximity of the diaphragm thereto.

348,512. Telephone and Telegraph Circuit; J. J. Carty, Cambridge, Assignor to the New England Telegraph and Telephone Co., of Boston, Mass. The object of this invention is to diminish the detrimental effects due to induction in long lines, to decrease the resistance of long circuits, and to increase the available capacity of the lines for transmitting and receiving. It is especially designed for telephone work. The invention consists principally, as shown in the cut, in employing two conductors in place of a single main line, and transmitting currents over both lines for operating the apparatus, and usually a third conductor, or the earth, is employed as a return-conductor. Like currents induced upon these two lines have equal and opposite effects upon the receiving apparatus, for each wire includes in its circuit a coil of the receiving-instrument, and these two coils oppose each other. The lines, after traversing



348,501. THERMAL TELEPHONE.

the receiving-instrument at each terminal station, are connected with each other and then with the return-conductor or with the earth. Other telegraphic or telephonic instruments may then be included in the conductors leading from the united lines to this return-conductor or to the earth.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.

ALL PERSONS SENDING FOR Catalogues or ordering articles advertised in our columns will do us and our Advertisers both a great favor by mentioning that they saw the advertisement in

THE ELECTRICAL WORLD.

FOR SALE.

Twenty-five pounds of No. 33 B. & S. Gauge German Silver Resistance Wire, English make, and 100 or more Magnets, 1,200 ohms each; size of core, ¾ diameter; length, 2 inches; diameter of head, 1¼ inches. A. S. BUNKER, 280 Common street, Lawrence, Mass.

WANTED.

An experienced man, competent to take charge of small electric light station, running both arc and incandescent lights. Address, at once,
W. E., care ELECTRICAL WORLD,
48 Congress St., Boston

WANTED.

By an Electrician, to take charge of Central Station; can make *any* repairs required, and would undertake to make an unsatisfactory plant a success. R. S. D., care THE ELECTRICAL WORLD, New York.

WANTED.

Competent man seeks situation; constructing new station or to take charge of one; can make all repairs, dynamos, lamps, etc. Address "W. B.," care THE ELECTRICAL WORLD, New York.

WANTED.

A man to take charge of the construction of electric light plants. Must be capable and trustworthy. Address at once, stating experience and giving references, "R. E.," care THE ELECTRICAL WORLD, 48 Congress street, Boston.

WANTED.

Experienced workmen accustomed to laying out and setting up incandescent plants. Also, first-class men experienced in installing arc plants. No communications will be noticed unless full particulars of experience, references, etc., are given. Address "PRACTICAL," care THE ELECTRICAL WORLD, New York.

NOVELTY ELECTRIC COMPANY.

Store, Factory and Wareroom, Fifth and Locust Sts., Philadelphia. Manufacturers of

Every Description of Electrical Goods Suited to the Requirements of the Trade.

Burglar Alarm Window Springs, per doz.	$1.44	New Short Line Morse Tel. Inst., per ½ doz.	$13.50
" " Door " " "	1.50	Novelty A Battery.....(doz. lots), each.	1.15
Push Buttons, Walnut, Ash, etc., per 100.	8.00	Novelty Disque Battery (case lots 50), each.	55
Hollow Base Switch, Walnut, etc., per 100.	20.00	Novelty Disque Battery Zincs (the best),	
Floor Push.....per doz.	3.60	per 100.....	50.00
Four-Point Needle Annunciator, with Bell.	5.00	Morse Telegraph Outfit, com. with battery.	3.00

SEND US A SAMPLE ORDER!

ELECTRICAL SUPPLY HOUSES

CAN SECURE EXCLUSIVE AGENCIES FOR

"THE BEST"

Electric Watch Clock.

ADDRESS

TARBOX TIME REGISTER COMPANY,

20 NORTH STREET, BOSTON.

DAY'S KERITE INSULATED

18 CONDUCTOR TELEGRAPH CABLE.

WIRES AND CABLES,
For Telephone, Telegraph and Electric Light Use, and Electrical Circuits Generally.

The reliability and durability of Kerite Insulation is unsurpassed, as has been proven by years of experience. All rubber and gutta-percha compounds are very short lived when placed either in the air or under ground, and the supposed new insulating compounds now being presented to the public, are most of them old and discarded experimental products. The present high standard and uniform quality of Kerite is the result of 30 years' experience.

The attention of **Telephone Managers** *is especially asked to our* **Anti-Induction** *Telephone cables, they being the most practicable and durable in the market.*

Telephone, Telegraph *and* **Electric Light Wires,** *for either* **submarine** *or* **underground** *work, a specialty. Estimates for complete systems of underground wires and conduits will be furnished on application.*

AUSTIN G. DAY, SOLE MANUFACTURER.

CLARK B. HOTCHKISS. Gen. Agent,
16 DEY STREET, NEW YORK.

MODEL and EXPERIMENTAL WORK A SPECIALTY. Send for Circulars. C. E. Jones & Bro. CINCINNATI, O. (Mention this Paper.)

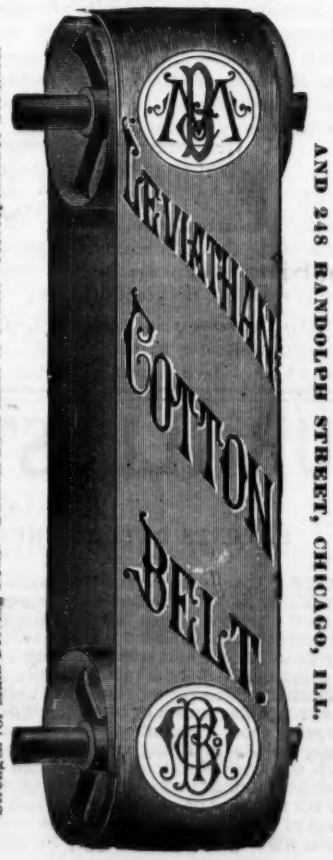
George H. Pride, Electrician. Telegraph Engineer and Contractor. 9 Dey Street, New York.

William Marshall, Mfr. of Elec. Condensers. Standards a Specialty. Rooms 2 and 4 University Building, cor. Waverley and University Places N. Y.

SHORTHAND Writing *thoroughly taught* by mail or personally. Situations procured all pupils when competent. Send for circular. W. C. CHAFFEE, Oswego, N. Y.

STANDARD
Electrical Test Instruments
Galvanometers, Resistance Coils, Condensers, Keys, Switches, &c., Bailey Combination Set, Pratt's Speed Indicator, &c.
Electric Mfg. Co., Troy, N. Y.
OFFICE 311 RIVER STREET

MAIN BELTING CO.
MANUFACTURERS OF THE



Of the Greatest Traction Power; Has no Equal, in fact, is THE BELT. Strongest and Cheapest Belting in the World for Electrical Purposes.
Unsurpassed for Strength, Durability and Cheapness. Made to any Length, Width and Strength for Main Driving Belts. Endless Belts Made to Order. Correspondence Solicited.
LEVIATHAN COTTON BELTING.
MAIN BELTING CO. S. W. Cor. Ninth and Read Streets, PHILADELPHIA, PA. U. S. A.
AND 248 RANDOLPH STREET, CHICAGO, ILL.